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PETROLEUM GASES TEST PLAN

Revised October, 2001

Submitted to the US EPA

by

The Petroleum HPV Testing Group

www.petroleumbpv.org

Consortium Registration #

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PLAIN LANGUAGE SUMMARY

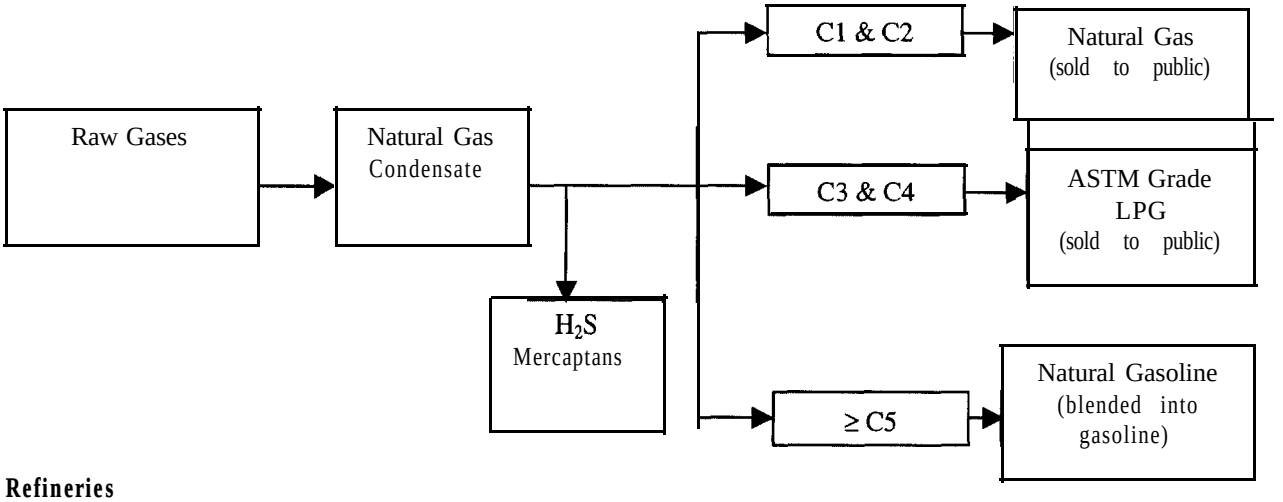
This test plan covers the gaseous substances that result from natural gas processing and petroleum refining operations. Most of these gases exist only as intermediates in closed systems in the refinery, with very few being sold as finished products. All of the substances in this group are comprised primarily of one to five carbon atom hydrocarbons. Some of the gases may also contain varying amounts of other components such as ammonia, hydrogen, nitrogen, hydrogen sulfide, mercaptans, carbon monoxide and carbon dioxide. Because the petroleum gases covered in this test plan are relatively simple mixtures whose primary components (simple alkanes) have low toxicities, the Testing Group expects that the overall hazard of any specific gas stream can be predicted based on the stream's composition and the toxicity characteristics of its components, including any inorganic components. This test plan will focus on ensuring that adequate data exists on the primary components of the petroleum gases, individual alkanes with carbon numbers from C_1 to C_4. To that end, selected toxicity tests will be done on the individual C_1 to C_4 saturated hydrocarbon components (methane, ethane, propane, butane, and isobutane). Testing being done under other HPV testing programs will provide information on the other components of the petroleum gas streams. The Testing Group will also perform testing on liquefied petroleum gas (LPG), a substance composed primarily of propane and butane, because it is one of the few substances in this category for which there is the potential for public exposure. The Testing Group does not believe aquatic or other environmental effects studies are warranted for materials in this category since they would not be expected to contaminate water, accumulate in the soil, or adversely affect plant life. Information on their environmental fate may be developed if appropriate.

THE PETROLEUM GASES CATEGORY

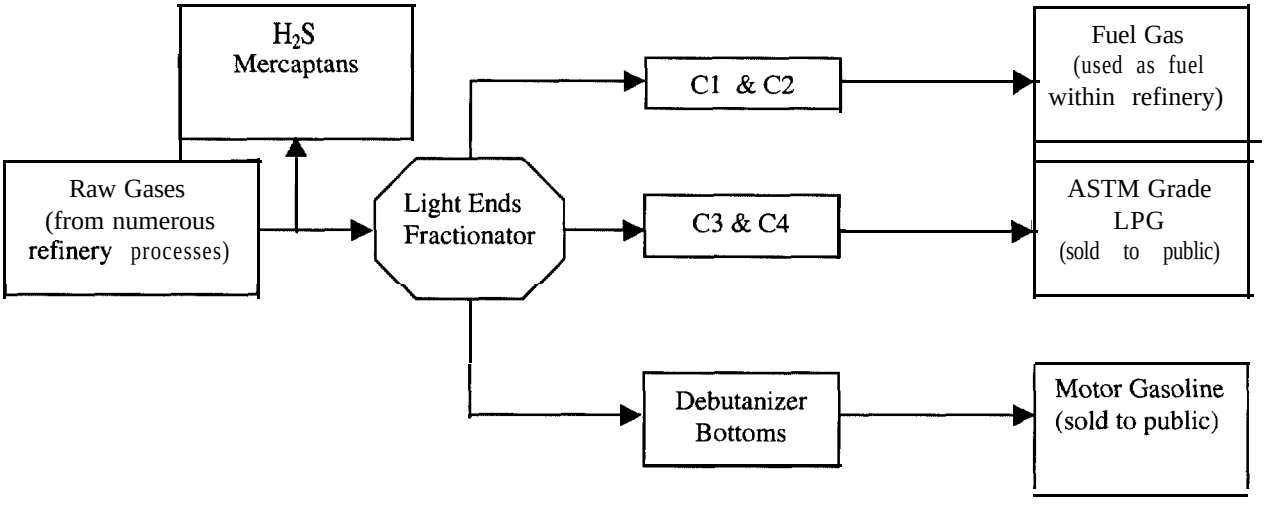
General Description

The Petroleum Gases category consists of a series of gases or highly volatile liquids, all of which are composed primarily of paraffinic, saturated hydrocarbons having one to five carbon atoms (C_1 to C_5). Some of the gases may contain lower molecular weight hydrocarbons, ammonia, hydrogen, nitrogen, hydrogen sulfide, mercaptans, carbon monoxide, or carbon dioxide. The substances in this test plan are primarily produced in petroleum refineries as the light end fractions of numerous distillation and cracking processes, or in gas plants that separate natural gas and natural gas liquids. As with most of the substances handled within the petroleum industry, these substances are commonly referred to as "refinery streams." Simplified diagrams of how these substances are processed are given below:

Gas Plants



Refineries



A few of the gas streams are pure substances, having only one component such as propane or butane, but most contain varying proportions of the individual components. Most of these gases exist only as intermediates in closed systems in the refinery, with very few being sold as finished products. Natural gas (methane) and LPG (predominantly propane) are the two substances in the Petroleum Gases category that are most commonly marketed

to the general public. In addition to their use as fuels, some of the simple alkanes have been used as anesthetics and propellants in spray cans. Most of these substances are identified on the Toxic Substances Control Act (TSCA) Chemical Inventory as Class II substances, "Chemical Substances of Unknown or Variable Composition, Complex Reaction Products and Biological Materials."

Category Rationale

The substances included in the Petroleum Gases category are similar from both a process and physical/chemical perspective. The Testing Group anticipates that since all the streams in this category are relatively simple mixtures, each substance's overall hazard is the result of an additive or independent effect of its various components, and as such can be predicted if the composition of the specific gas stream is known. The additive/independent effect of the petroleum gas components is supported by existing studies. Eide reported no interaction between 3 C_9 n-paraffinic, naphthenic and aromatic hydrocarbons with respect to absorption and distribution in rats (Eide et al., 1996). Aviado found that a mixture (80% isobutane, 2.5% butane, 17% propane) had a similar LC_{50} as isobutane alone (Aviado, 1977). In a more general sense, in a review of studies on combined exposures over 7 years, Ikeda found that in 80% of the studies, observed effects were either additive or less than additive (Ikeda, 1988). In their "Guidelines for the Health Risk Assessment of Chemical Mixtures" EPA recognized the soundness of assuming additivity:

> Several studies have demonstrated that dose additive models often predict reasonably well the toxicities of mixtures composed of a substantial variety of both similar and dissimilar compounds (Pozzani et al., 1959; Smyth et al., 1969, 1970; Murphy, 1980). The problem of multiple toxicant exposure has been addressed by the American Conference of Governmental Industrial Hygienists (ACGIH, 1983), the Occupational Safety and Health Administration (OSHA, 1983), the World Health Organization (WHO, 1981), and the National Research Council (NRC, 1980a,b). Although the focus and purpose of each group was somewhat different, all groups that recommended an approach elected to adopt some type of dose additive model (EPA, 1986).

The petroleum gas components can be grouped into component classes (e.g., alkanes, olefins, alkadienes, alkynes, aromatics, mercaptans, and inorganics). Within a component class, individual components are structurally similar and can be expected to have similar biologic activities, act through similar mechanisms, share similar metabolic pathways, and have comparable environmental fate and transport characteristics. For example, within the alkane category, branching (isomerization) of an alkane chain lowers the boiling point from that of the straight chain isomer. Highly volatile and branched hydrocarbons are not absorbed as well as less volatile and unbranched hydrocarbons; unsaturated compounds are better absorbed than saturated ones (API, 1987). Generally, branched-chain derivatives are less acutely toxic than the corresponding parent straight-chain alkanes. Odorant and narcotic or anesthetic properties increase with increasing chain length. Both skin and respiratory tract irritant properties increase with increasing chain length up to C_{14} derivatives (Galvin et al., 1999).

Table 1 presents both the component classes that are found in the Petroleum Gases and the respective members of each component category. The Testing Group has placed all inorganic components into a single component class, "inorganics."

It should be noted that several of the CAS descriptions of substances found in this category reference hydrocarbon components with carbon numbers from six to eight. However, under "real world" conditions, these C_5 to C_7 hydrocarbons are not found in either LPG or Natural Gas, the two category members to which there is public exposure. The absence of the C_5 to C_7 hydrocarbons in either LPG or Natural Gas is due to:

1. strict product specifications (see Table 2),
2. C_5 to C_7 hydrocarbons being liquids, not gases, under normal conditions, and
3. economic factors that encourage refiners to maximize the quantity of C_5 to C_7 hydrocarbons directed to gasoline related streams.

With the exception of benzene, the C_5 to C_7 substances are being addressed in the Test Plan for gasoline blending streams. The Testing Group thinks the existing data on benzene is adequate and no testing of benzene is being proposed under this test plan.

Table 1. Petroleum Gases Component Classes

Category	Petroleum Gases						
Component Class	Alkanes	Olefins	Alkadienes	Alkynes	Aromatics	Inorganics	Mercaptans
Component CAS No.	Methane* 74-82-8	Ethylene* 74-85-1	Propadiene 463-49-O	Ethyne 74-86-2	Benzene 7 l-43-2	Hydrogen sulfide 7783-06-4	Methanethiol 74-93-1
	Ethane* 74-84-O	Propylene* 115-07-l	1,2 –Butadiene 590-19-2			Ammonia 7664-41-7	Ethanethiol 75-08-l
	Propane* 74-98-6	1-Butene* 106-98-9	1,3- Butadiene 106-99-0			Hydrogen 1333-74-o	
	Butane* 106-97-8	2-Butene* 107-01-7	1,2- Pentadiene 591-95-7			Nitrogen 7727-37-9	
	Pentane* 109-66-0	Propene, 2-methyl* 115-11-7	1-cis-3-Pentadiene 1574-41-0			Carbon dioxide 124-38-9	
	Propane, 2-methyl* 75-28-5	1-Pentene 109-67-l	1-trans-3-Pentadiene 2004-70-g			Carbon monoxide 630-08-0	
	Butane, 2-methyl* 78-78-4	Cis-2-Pentene 627-20-3	1,4 –Pentadiene 59 l-93-5				
	Cyclopentane 287-92-3	Trans-2-Pentene 646-04-8	2,3- Pentadiene 591-96-x				
		1-Butene, 2-methyl 563-46-2	1,2- Butadiene, 3- methyl 598-25-4				
		1-Butene, 3-methyl 563-45-1	1,3- Butadiene, 2- methyl 78-79-5				
		2-Butene, 2-methyl 513-35-9	Cyclopentadiene 542-92-7				
		Cyclopentene 142-29-o					

* one of the most abundant components in petroleum gas streams

Note: Table 1 lists all possible isomers of C_1 to C_5.

Included Substances

Appendix 1 provides a complete listing of substances included in the Petroleum Gases category.

As can be seen in Appendix 1, the descriptions accompanying the CAS number of each petroleum gas are written in broad, general terms. The descriptions often contain ranges of values, with little if any quantitative analytical information or concern for possible compositional overlaps. As a result, the CAS descriptions are not useful in determining the exact composition of any specific refinery stream. Furthermore, because of the qualitative nature of these CAS descriptions, there may be significant compositional overlap between two refinery streams with different CAS numbers, not only within the petroleum gas category, but also with streams in other categories.

The CAS descriptions for refinery streams, including the petroleum gases, were intentionally written to be qualitative in nature. Section 8(b) of the Toxic Substances Control Act required identification and registration with the Environmental Protection Agency before July 1979 of each "chemical substance" being manufactured, processed, imported or distributed in commerce. Chemical substance was initially interpreted to mean an individual, distinct molecular compound. Due to analytical limitations, identification of every specific individual molecular compound in every refinery process stream under all processing conditions was impossible. In addition, there is known variability in stream composition due to things such as the crude oil used and small changes in process conditions. Even with reference to TSCA's Candidate Inventory List, members of the industry would have reported refinery streams using a wide variety of names, with each company's differing from all others. Perhaps 3000 or more different names for refinery streams would have been submitted to the EPA by the petroleum industry. Recognizing these problems, in 1977 API initiated an effort to compile a list of terms consistent with industry operations and with nomenclature included in API's Thesaurus of petroleum industry technical terms.

As a result of this effort, API recommended to the EPA a list of generic names for refinery streams covering all known processes used by refiners. A definition of each stream was included, giving typical carbon number distribution, boiling or viscosity range, or general composition. Along with CAS numbers, this information was published by EPA as "Addendum I, Generic Terms Covering Petroleum Refinery Process Streams."

In the API exercise, process history was one of the primary criteria used to differentiate streams and assign CAS numbers. As a result, streams with the same or substantially similar compositions may have different CAS numbers if they originate in different process units. For example:

> 068513-18-8
> Gases (petroleum), reformer effluent high-pressure flash drum off
> A complex combination produced by the high-pressure flashing of the effluent from the reforming reactor. It consists primarily of hydrogen with various small amounts of methane, ethane, and propane.
>
> 068513-19-g
> Gases (petroleum), reformer effluent low-pressure flash drum off
> A complex combination produced by low-pressure flashing of the effluent from the reforming reactor. It consists primarily of hydrogen with various small amounts of methane, ethane, and propane.

Because the API process assigned CAS numbers and descriptions primarily on the basis of process history, and not differences in composition, the one hundred sixty one CAS numbers included in the Petroleum Gases category does not mean there are large compositional differences between the category members. It simply reflects the fact that these streams (many similar in composition) are produced in a large number of process units within a refinery. As noted above, because of the qualitative nature of these CAS descriptions, there may be significant compositional overlap between two streams with different CAS numbers. In fact, the gas streams included in this test category are all comprised of the same, limited number of basic hydrocarbons (and in some cases inorganic components) that vary only in their relative abundance and occurrence.

A Category Matrix for SIDS Endpoints

It is the Testing Group's expectation that the hazards of the gas streams comprising this category are the result of an additive or independent effect of their components. As such, the value for a specific SIDS endpoint can be estimated

if the composition of the specific gas stream is known. However, the Testing Group finds little value or technical merit in making such predictions based on the qualitative compositional data contained in the CAS descriptions of the various category members. Thus, the Testing Group has not included in this test plan a matrix relating the CAS numbers of the individual category members to the various SIDS endpoints.

Instead, the Testing Group has chosen to focus this test plan on the assessment of individual components of the petroleum gases in this category. The data on the various component categories are displayed in a series of matrices relating data on individual components to specific SIDS endpoints. In taking this approach, the Testing Group thinks it has provided "tools" that will allow the assessment of the SIDS endpoints for a specific gas, but only after that gas has been analyzed and its detailed composition determined.

TEST SAMPLES

To supplement existing data on the individual components of the gas streams, the Testing Group will conduct selected toxicity tests on the individual C_1 to C_4 saturated hydrocarbons (methane, ethane, propane, butane, and isobutane). Other Testing Groups will summarize available information and conduct testing on other petroleum gas components (see "Coordination with Other Test Programs").

The Testing Group has included LPG in the testing matrix proposed under this plan. LPG is the mixture in this category to which there is a potential for widespread, low-level public exposure. In addition, the Testing Group has entered into an agreement to conduct joint testing on LPG to generate data for EU risk assessment purposes. Accordingly, the testing planned for LPG will be more extensive than that for the individual alkanes and somewhat beyond the scope of the HPV program. This is discussed further in the section on the proposed testing for LPG.

Test Sample Characterization

Saturated Hydrocarbons (methane, ethane, propane, butane, and isobutane)
Samples will be of very high purity (>98%). Specific analytical data will be available when test samples are obtained.

LPG
LPG has been selected for testing because among all the substances in the petroleum gases category, it has the highest potential for exposure amongst the general public. LPG is composed of predominantly propane. Hydrocarbons with carbon numbers ≥ C5 are found at very low percentages, if at all, in selected petroleum gas refinery streams. These heavier molecular weight hydrocarbons are found in much higher percentages in refinery streams being tested under other HPV Test Plans (e.g., the Gasoline Test Plan).

Specific analytical data on the LPG test sample will be available when the sample is obtained. The test sample will be representative of commercially available LPG. Representative analyses of two such materials, HD-10 and HD-5, are shown in Table 2.

Table 2. Composition of Two Commercially Available LPGs*

Components	HD-10	HD-5
Propane	≥ 85% (liquid volume)	≥ 90% (liquid volume)
Propylene	≤ 10% (liquid volume)	≤ 5% (liquid volume)
Butanes & heavier	≤ 5% (liquid volume)	≤ 2.5% (liquid volume)
Butenes	≤ 2% (liquid volume)	
Pentanes & heavier	≤ 0.5% (liquid volume)	
Hydrogen sulfide	≤ 1 ppm	≤ 123 ppm (total sulfur)

* also ASTM specifications

COORDINATION WITH OTHER TEST PROGRAMS

The Petroleum HPV Testing Group is coordinating its efforts with other testing consortia to avoid duplication of effort and unnecessary use of animals. The OECD/SIDS program, the American Chemistry Council's Olefins and Hydrocarbon Solvents Panels, and the Mercaptan/Thiol Council are all developing data on selected components of the petroleum gases. Table 3 provides an overview of how data from these other test programs will complement the Testing Group's efforts. Conversely, the data being generated under this Test Plan has the potential to reduce testing by other programs in which the C_1-C_5 alkanes are major components.

Because of compositional overlaps, other test programs involving mixtures may also produce data that can be used to evaluate the potential hazards of the individual components of petroleum gases. A listing of those test mixtures that the Petroleum Gases Testing Group has identified as being relevant to this plan can be found in Table 4. Additional examples may become known as the details of other test programs are posted on the EPA HPV web site.

Table 3. Petroleum Gases: Component Data From Other Test Programs

Component Class	Alkanes	Olefins	Alkadienes	Alkynes	Aromatics	Inorganics	Mercaptans
Component CAS No.	Methane 74-82-8	Ethylene[c] 74-85-1	Propadiene 463-49-O	Ethyne[f] 74-86-2	Benzene 7 I-43-2'	Hydrogen sulfide 7783-06-4	Methanethiol[d] 74-93-1
	Ethane 74-84-6	Propylene" 115-07-l	1,2 -Butadiene 590-19-2			Ammonia 7664-41-7	Ethanethiol[d] 75-08-1
	Propane 74-98-6	1-Butene[a] 106-98-9	1,3- Butadiene[c] 106-99-O			Hydrogen 1333-74-o	
	Butane 106-97-g	2-Butene[c] 107-01-7	1,2- Pentadiene 591-95-7			Nitrogen 7727-37-9	
	Propane, 2-methyl 75-28-5	Propene, 2-methyl' 115-11-7	1-cis-3-Pentadiene 1574-41-o			Carbon dioxide 124-38-9	
	Pentane[c] 109-66-O	1 -Pentene 109-67-1	1-trans-3-Pentadiene 2004-70-8			Carbon monoxide 630-08-o	
	Butane, 2-methyl[b] 78-78-4	Cis-2-Pentene 627-20-3	1,4 -Pentadiene 591-93-5				
	Cyclopentane[b] 287-92-3	Trans-2-Pentene 646-04-S	2,3- Pentadiene 591-96-8				
		I-Butene, 2-methyl 563-46-2	1,2- Butadiene, 3- methyl 598-25-4				
		I-Butene, 3-methyl 563-45-l	1,3- Butadiene, 2- methyl[a] 78-79-5				
		2-Butene, 2-methyl[a] 5 13-35-9	Cyclopentadiene 542-92-7				
		Cyclopentene 142 29 0					

[a]ACC Olefins Panel [b]ACC Hydrocarbon Solvents Panel [c]OECD/SIDS Program [d]Mercaptans/Thiols Council [e] CEFIC Lower Olefins Sector Grp in ICCA
[f]ACC Acetylene Consortium

Table 4. Petroleum Gases: Complementary and From Other Test Programs						
Petroleum Gas Component (% volume)	Pyrolysis C5s[a]	Hydrotreated C5s[a]	Mid-Range 1,3 Butadiene[b]	Mid-Range 1,3 Butadiene[b]	Low 1,3 Butadiene[b]	Vapor Recovery Gasoline[c]
Isoprene (2-Methyl-1,3-Butadiene)	9 - 25	2		-	-	
1,4-Pentadiene	1 - 6	-		-	-	
1,3-Pentadiene (isomer mix)	6 - 23	2		-	-	
1,3-Butadiene	0 - 3	-	67	45	10	≤0.04
1,2-Butadiene			2	-	-	
Cyclopentene	1- 11	15 - 20		-	-	0.22
Cyclopentane	0 - 2	2				
Isopentene		15 - 20		-	-	
1-Pentene (Amylene)	3 - 12	-		-	-	10.03
2-Pentene (isomer mix)	2 - 10	-		-	-	10.03
2-Methyl-2-Butene	1 - 5	11		-	-	1.76
2-Methyl- 1-Butene	1 - 8	-		-	-	
3-Methyl-1-Butene (Isoamylene)	0 - 12	-		-	-	0.26
Isopentane (2-Methylbutane)	3 -29	15 -25		-	-	27.22
Toluene						0.67
Heptanes/haptanes	-	-				0.37
Octanes	-	-				0.18
Benzene	-	-				0.64
Hexanes/hexenes	-	-		-	-	8.25
1-Hexene	-	-		-	-	≤0.03
n-Pentene	-	10 - 15		-	-	-
Pentane	4 - 30	15 - 20		-	-	7.76
Benzene	0 - 1	1		-	-	
Propylene	-	-		-	-	≤0.04
Propane				-	-	0.99
Isobutane	-	-		-	-	7.61
Butanes	-	-		20	-	38.24
1-Butene	-	2	30 (total butenes)	30 (total butenes)	-	5.82 (total butenes)
2-Butene (isomer mix)	0 - 1	-			-	

[a]ACC Olefins Panel C5 Non-cyclic Test Plan
[b]ACC Olefins Panel Crude Butadiene C4 Test Plan
[c]CONCAWE 2-generation toxicity test (McKee, R.H. et al., 2000)

EVALUATION OF EXISTING DATA AND PROPOSED TESTING

General

This test plan is based on the expectation that since all the substances in this category are relatively simple mixtures, each substance's overall hazard is the result of an additive or independent effect of its components. As such, the hazards of these mixtures can be predicted if the composition of the specific gas is known. Accordingly, the Testing Group assessed the adequacy of existing data and recommended testing (if appropriate) for:

1. each of the component classes within the petroleum gases category, and
2. a single representative mixture of these components.

The Testing Group's evaluation and testing proposals were done in a manner consistent with EPA's guidance, which states:

> The goal of the HPV Challenge Program (and the related OECD SIDS Program) is to develop a screening level of understanding of the hazards presented by the chemical and make summary information available to the public. Given the ultimate use of the test data will be for screening level assessment, as opposed to a detailed risk assessment, it may be reasonable not to require definitive toxicological equivalence and hence the issue of test substance selection maybe somewhat diminished. However, the test substance selected must at some level be sufficiently representative to minimize incorrect hazard screening judgments.

The exception to this is the more detailed testing of LPG that is being conducted jointly with European companies for EU risk assessment purposes.

Detailed summaries of the available toxicology data for the test samples, in the form of the Robust Summaries, are included in this test plan (Appendix 2).

Components

Alkanes

A summary of the available data and proposed testing on the alkane components of petroleum gases can be found in Table 5 "Alkanes: Matrix of Available Data and Proposed Testing."

HEALTH EFFECTS

Acute Toxicity

Much is already known about how petroleum gases and their components affect the body. The simple alkanes, which are the major components of these gases, do not cause harmful effects at low concentrations. Propane, n-butane and isobutane are considered by the U.S. Food and Drug Administration to be Generally Recognized as Safe (GRAS) when used as "propellants, aerating agents and gases" and can be used in food products provided their purity meets food grade specifications and their levels do not exceed current good manufacturing practice. This GRAS designation is based in part on the low human exposures from these uses (about 26 mg per day), the lack of biological observations on animals subsisting on foods treated with the substances, and the fact that the gases are inert to most reagents, suggesting the relative harmlessness of exposing foods to the substances (U.S. FDA, 1982).

At very high concentrations the simple alkanes can displace oxygen in the air and reduce the amount available for breathing, leading to asphyxiation (or suffocation) from lack of oxygen. Symptoms of overexposure to petroleum gases can include shortness of breath, drowsiness, headaches, confusion, and decreased coordination. These symptoms are reversible if exposure is stopped. The American Conference of Governmental Industrial Hygienists (ACGIH) considers methane and ethane to be simple asphyxiants. Of these simple alkanes, the higher molecular weight substances (propane and butane) can also have a mild depressant effect on the nervous system. Exposure is rare at levels that produce these symptoms, since these levels also present an explosive hazard. Occupational exposure limits have been established by ACGIH for propane, butane, and LPG based on asphyxiation and CNS effects.

Investigations of workers bottling liquefied propane and butane reported complaints of respiratory symptoms (e.g., dry cough and dry throat together with gastrointestinal effects). The electrocardiographic findings in some workers indicated sinus tachycardia, extrasystole and incomplete right bundle branch block. Lactic acid production in workers experiencing propane "poisoning" has been reported as slight. In a controlled exposure study, adult volunteers of both sexes were exposed to isobutane at concentrations ranging from 250 to 1000 ppm [=594-2377 mg/m^3]. There were no untoward responses seen at exposure periods of 1 and 2 minutes, and 1, 2 and 8 hours. The volunteers were then exposed repetitively to isobutane at a concentration of 500 ppm [=1189 mg/m^3] for 1, 2 or 8 hours a day, five days a week for two weeks. This was followed by studying the effects of exposure to two mixtures of isobutane and propane for 1, 2 or 8 hours a day for two days. No untoward subjective or physiological responses were recorded either during or after the exposures.

LC_{50}s in rats were >800,000 ppm for propane exposure for 15 minutes, >570,000 ppm for isobutane exposure for 15 minutes, and 276,000 ppm for butane exposure for 4 hours. The EC_{50} for central nervous system (CNS) depression was reported to be 280,000 ppm after a lo-minute exposure of rats to propane. However, isobutane was reported to cause CNS stimulation in rats with an EC_{50} at levels of 200,000 ppm for 10 minutes. Petroleum gases have been reported to sensitize the heart to epinephrine in experimental animals at levels of 70,000 ppm. While no specific studies were located, petroleum gases are generally not considered to be eye or skin irritants in their gas or vapor form, however, as liquids, they can cause frostbite.

Summary: The results of both human and animal studies have been consistent. Therefore, no additional testing is planned.

Repeated Dose Toxicity and Reproductive and Developmental Toxicity

No repeated dose studies were found on the individual gases. A repeated dose inhalation study was conducted using male and female rats exposed to 50:50 mixtures of either n-butane/n-pentane or isobutane/isopentane for the purpose of examining possible nephrotoxic effects. Exposure was for 6 hours/day, 5 days/week for 90 days. Necropsies were performed on one-half of the male rats after the twentieth exposure. Exposure levels were 0, 1017, and 4489 ppm. After gross necropsy of all tissues for the presence of lesions and other abnormal conditions, only liver and kidney weights were determined. All major tissues were collected and fixed, but only kidneys were examined histologically. Body weights, taken weekly, were statistically decreased compared to control by weeks three and four in both sexes. These effects were reversed in male rats but not female rats by the end of the study. A slight nephrotoxic response observed at the interim examination was not observed at the end of the study. The NOAEL was 4489 ppm for 90 days. Although a GLP study, the limitations of this study were the lack of complete histological examinations of tissues, including reproductive organs, and the lack of clinical chemistry and hematological analyses. No effects were observed at ~¼ the Lower Explosive Limit (LEL) of these chemicals, suggesting that higher doses need to be tested.

The Test Group continues to believe the physical properties and ubiquitous presence of methane in the environment (including being a metabolic product of intestinal bacteria in humans) make health effects testing on methane unnecessary.

No useable reproductive or developmental toxicity test data were identified.

Summary: A study utilizing a combination of gases did not include sufficient histological examinations or clinical chemistry/hematological analyses. Ethane, propane, butane, and isobutane will be tested via inhalation using a 28-day combined, repeated dose and reproductive/developmental toxicity screening protocol (OECD Test Guideline 422).

In Vitro Genetic Toxicity

Six gases, predominantly (i.e., >96% purity) propane, n-butane, two isobutanes, n-pentane, and isopentane, have been tested for bacterial mutagenicity using the Ames Assay. Bacterial strains used included *Salmonella typhimurium* TA98, TA100, TA1535, TA1537, and TA1538 with and without metabolic activation. A modified test protocol (OECD Test Guideline 471) was used to test the gaseous substances at levels of 5, 10, 20, 30, 40, and 50% in air. Methylene chloride was used as a positive control in the study. Toxicity to some of the gases, but not mutagenicity, was observed. Mutagenicity was not observed when the gases were retested at lower, non-toxic levels.

The Testing Group considered the use of *in vitro* systems to test for chromosomal effects, However, the Testing Group decided against conducting these tests because:

1. The *in vitro* test system would need to be modified so that exposures would be done in culture flasks that could be dosed with the gas, then closed and kept sealed during the incubation period, meaning it would not be possible to expose to the gas and maintain exposure to 5% CO_2 in air. Bicarbonate buffers could be used to maintain pH in a reasonable range, but these culture conditions are not ideal for the cells.
2. Exposure of the cells to the gas would be limited because they would be attached to the substrate, under the surface of the culture medium, and most of the gas would stay in the air above the medium. Exposure concentrations would be nominal, and would substantially overestimate the exposure concentrations experienced by the cells.
3. There is the possibility of an explosion hazard. First, because the incubators used for cell culture have temperature controls and wiring that can create sparks and second, because some gas will escape from the polystyrene culture flasks due to the flasks limited ability to contain gases.

Summary: The use of methylene chloride as a positive control in the existing studies has been shown to be problematic. Consequently, methane, ethane, propane, butane, and isobutane will be tested using the Ames Assay (OECD Test Guideline 471).

In Vivo Genetic Toxicity

No useable *in vivo* genetic toxicity data was identified.

Summary: Testing of the individual alkane components will be considered if the mammalian genetic toxicity study (OECD Test Guideline 474, micronucleus assay) on LPG is positive.

PHYSICOCHEMICAL DATA

Available data on methane, ethane, propane, butane, and isobutane can be found in the appropriate robust summary for these materials. The range of values for these chemicals cover the substances included in the petroleum gases category.

Summary: When measured values are not available from the literature for methane, ethane, propane, butane, and isobutane, values will be calculated as described in the EPA document titled, *The Use of Structure-Activity Relationships (SAR) in the High Production Volume Chemicals Challenge Program* (U.S. EPA, 1999a)**.**

ENVIRONMENTAL/ECOTOXICITY DATA

Environmental Fate Data

Volatilization of C_1 through C_5 alkanes to the vapor phase in the ambient atmosphere and subsequent reaction with hydroxyl radicals is expected to be the most significant fate process. Calculated atmospheric half-lives for methane, ethane, propane, butane, and isobutane are in the appropriate robust summaries. Fugacity modeling supports the Testing Group's position that data on other environmental fate processes will either be much less or not relevant when assessing the fate of these substances. Biodegradation and adsorption may occur in soil and water to a much lesser extent, but are not predominant behaviors for these gases, due to atmospheric partitioning. Photolysis, hydrolysis and bioconcentration of methane are not expected to be relevant environmental fate processes. Predictive computer models will be used to develop meaningful environmental fate data. Although there are some data for these substances, additional information will be prepared.

Photodegradation:

Direct photochemical degradation occurs through the absorbance of solar radiation by a chemical substance. If the absorbed energy is high enough, the resultant excited state of the chemical may undergo a transformation. Simple chemical structure can be examined to determine whether a chemical has the potential for direct photolysis in water. First order reaction rates can be calculated for some chemicals that have a potential for direct photolysis using the procedures of Zepp and Cline (Zepp and Cline, 1977). Photodegradation can be measured (EPA identifies OECD Test Guideline 113 as a test method) or estimated using computer models

accepted by the EPA (US. EPA, 1999a,b). An estimation method accepted by the EPA includes the calculation of chemical specific atmospheric oxidation potentials (AOP). Atmospheric oxidation can occur as a result of hydroxyl radical attack. This reaction is not direct photochemical degradation, but rather indirect degradation and can be calculated using a computer model. Chemicals that are gases will be available for atmospheric oxidation reactions with photochemically generated hydroxyl radicals. This will be the most significant route of degradation in the environment for the chemical components comprising petroleum gases. Although there are data for photodegradation in the robust summaries for methane, ethane, propane, butane, and isobutane, their quality cannot be confirmed.

Summary: Relevant atmospheric degradation data of methane, ethane, propane, butane, and isobutane will be calculated using the computer program AOPWIN (EPIWIN, 1999). This program calculates a chemical half-life based on an overall OH reaction rate constant during a 12-hr day and a standard OH concentration (a 12-hr period is used because this reaction occurs during daylight).

Stability in Water:
Hydrolysis of an organic chemical is the transformation process in which a water molecule or hydroxide ion reacts to form a new carbon-oxygen bond. Chemicals that have a potential to hydrolyze include alkyl halides, amides, carbamates, carboxylic acid esters and lactones, epoxides, phosphate esters, and sulfonic acid esters (Neely, 1985). The chemical components that comprise the Petroleum Gases category are hydrocarbons, which are not included in these chemical groups, and they are not subject to hydrolysis reactions with water.

Stability in water can be measured (EPA identifies OECD Test Guideline 111 as a test method) or estimated using computer models accepted by the EPA (U.S. EPA, 1999a,b). HYDROWIN (aqueous hydrolysis rate program for Microsoft windows) is an estimation method accepted by the EPA that can be used to calculate hydrolysis rate constants for esters, carbamates, epoxides, halomethanes, and selected alkylhalides (EPIWIN, 1999). It will not be necessary to run the model for the chemical components in this category because they do not fall within these chemical groups. Hydrolysis is not a significant process since hydrocarbons such as the simple alkanes are not subject to hydrolysis reactions with water. Consequently, the use of tests (OECD Test Guideline 111) or computer models (HYDROWIN®) to determine stability in water is inappropriate (EPIWIN, 1999; U.S. EPA, 1999a,b; Harris, 1982).

Summary: Hydrolysis testing and computer modeling will not be conducted for the simple alkanes. Instead, a technical discussion on the potential for methane, ethane, propane, butane, and isobutane to hydrolyze will be prepared.

Chemical Transport and Distribution in the Environment:
Fugacity based multimedia modeling can provide basic information on the relative distribution of chemicals between selected environmental compartments (i.e., air, soil, sediment, suspended sediment, water, and biota). The U.S. EPA has acknowledged that computer-modeling techniques are an appropriate approach to estimating chemical partitioning (fugacity is a calculated endpoint and is not measured). A widely used fugacity model, the EQC (Equilibrium Criterion) model, Level I (Mackay et al., 1996), will be used to calculate distribution values for methane, ethane, propane, butane, and isobutane. EPA cites the use of this model in its document titled *Determining the Adequacy of Existing Data* (U.S. EPA, 1999b). A computer model, EPIWIN - version 3.02 (EPIWIN, 1999), will be used to calculate the properties needed to run the Level I EQC model. After careful, in-depth review, the Testing Group decided that the use of the EQC Level III model is, at this time, an inappropriate approach to evaluating petroleum mixtures transport and distribution behavior. They reached this conclusion due to the lack of accurate emissions data and algorithms estimation limitations based on chemical specific properties.

Summary: Fugacity data for methane, ethane, propane, butane, and isobutane will be calculated using the EQC Level I model.

Biodegradation:
Biodegradation is the utilization of a chemical by microorganisms as a source of energy and/or carbon. The chemical is broken down to simpler, smaller chemicals, which are ultimately converted to an inorganic form such as carbon dioxide, nitrate, sulfate, and water. Biodegradation of C_1 through C_5 alkanes may occur in soil

and water. Available data indicates that these gases are expected to be inherently biodegradable. Although the reliability of existing data for the biodegradation of methane, ethane, propane, butane and isobutane cannot be confirmed, biodegradability of these hydrocarbons have been extensively studied and summarized under additional biodegradation comments. Since biodegradability of these hydrocarbons have been well documented, information on the biotic fate of these gases can be considered adequate.

Summary: A technical discussion will be written describing the extensive research identifying the inherent biodegradability of the alkanes.

Ecotoxicity Data

Measured aquatic toxicity data do not exist for these substances. Given the water solubility and vapor pressure properties of these gases, multimedia modeling predicts these gases will not partition into water and persist at concentrations where adverse effects would be expected to occur. Therefore, based on partitioning behavior, aquatic toxicity testing will not be conducted. In lieu of measured data, toxicity values will be calculated by ECOSAR analysis procedures using structure-activity relationships (SARs). Using the measured aquatic toxicity values and estimated K_{ow} values (octanol/water partition coefficient), regression equations can be developed for a class of chemicals. Toxicity values are then calculated by inserting the estimated K_{ow} into the regression equation and correcting the resultant value for the molecular weight of the compound. Most SAR calculations in the ECOSAR Class Program are based upon the K_{ow}. ECOSAR Class Program is a computerized version of the ECOSAR analysis procedures as currently practiced by the EPA Office of Pollution Prevention and Toxics. The estimated toxicity values for these gases may be considered reliable with restrictions, as the gaseous chemicals are not represented in the ECOSAR program by test data for surrogate chemicals. An assessment of the aquatic toxicity of these gases will be prepared in the robust summaries based on an evaluation of predicted toxicity values, water solubility and partitioning behavior.

Summary: Fish, aquatic invertebrate, and algae toxicity studies will not be conducted. Instead, a technical discussion will be developed that addresses the physical nature of these substances as well as the fact that the primary compartment to which these products will partition is the air. This statement will include a discussion of calculated aquatic toxicity data for methane, ethane, propane, butane, and isobutane. The calculated data will be developed using ECOSAR, a SAR program found in EPIWIN (EPIWIN, 1999).

Table 5. Alkanes: Matrix of Available Data and Proposed Testing

Component CAS #	Methane 74-82-8	Ethane 74-84-0	Propane 74-98-6	Butane 106-97-8	Isobutane 75-28-5	Pentane 109-66-0	Butane, 2-methyl 78-78-4	Cyclopentane 287-92-3
Melting Point	A	A	A	A	A			
Boiling Point	A	A	A	A	A			
Vapor Pressure	A	A	A	A	A			
Partition Coefficient	M	M	M	M	M			
Water Solubility	A	A	A	A	A			
Photodegradation	M	M	M	M	M			
Stability in Water	D	D	D	D	D			
Transport and Distribution	M	M	M	M	M			
Biodegradation	A/D	A/D	A/D	A/D	A/D			
Acute Toxicity to Fish	M/D	M/D	M/D	M/D	M/D			
Acute Toxicity to Aquatic Invertebrates	M/D	M/D	M/D	M/D	M/D			
Toxicity to Algae	M/D	M/D	M/D	M/D	M/D			
Acute Inhalation	A	A	A	A	A			
Repeated Dose	I/E	T	T	T	T			
Genotoxicity, bacterial	T	T	T	T	T			
Genotoxicity, *in vivo*	I/E	I/E	I/E	I/E	I/E			
Repro/Developmental	I/E	T	T	T	T			

OECD/SIDS Program

ACC Hydrocarbon Solvents Panel

ACC Hydrocarbon Solvents Panel

A = adequate data available T = test (experiment) proposed M = modeling proposed D = technical discussion proposed I /E= data to be interpolated/extrapolated from available and/or proposed data

Olejins

As can be seen from Table 6 "Olefins: Matrix of Available Data and Proposed Testing," several of the olefin components found in petroleum gases are being considered under other test programs. The Testing Group anticipates that the data generated from these programs can provide the basis for deriving estimates of the SIDS endpoint values for the remaining members of the component class.

Summary: No additional testing is planned.

Table 6. Olefins: Matrix of Available Data and Proposed Testing

Component CAS #	Ethylene 74-85-1[e]	Propylene 115-07-1[f]	1-Butene 106-98-9	2-Butene 107-01-7	Propene, 2-methyl 115-11-7	1-Pentene 109-67-1	Cis-2-Pentene 627-20-3	Trans-2-Pentene 646-04-8	1-Butene, 2-methyl 563-46-2	1-Butene, 3-methyl 563-45-1	2-Butene, 2-methyl 513-35-9	Cyclo-pentene 142-29-0
Melting Point	OECD/SIDS Program	CEFIC Lower Olefins Sector Grp in ICCA	ACC Olefins Panel	OECD/SIDS Program	OECD/SIDS Program	Data to be interpolated/extrapolated from available and/or proposed data	Data to be interpolated/extrapolated from available and/or proposed data	Data to be interpolated/extrapolated from available and/or proposed data	Data to be interpolated/extrapolated from available and/or proposed data	Data to be interpolated/extrapolated from available and/or proposed data	ACC Olefins Panel	Data to be interpolated/extrapolated from available and/or proposed data
Boiling Point												
Vapor Pressure												
Partition Coefficient												
Water Solubility												
Photodegradation												
Stability in Water												
Transport and Distribution												
Biodegradation												
Acute Toxicity to Fish												
Acute Toxicity to Aquatic Invertebrates												
Toxicity to Algae												
Acute Inhalation												
Repeated Dose												
Genotoxicity, bacterial												
Genotoxicity, *in vivo*												
Repro/Develop												

Alkadienes

As can be seen from Table 7 "Alkadienes: Matrix of Available Data and Proposed Testing," several of the alkadiene components found in petroleum gases are being considered under other test programs. The Testing Group anticipates that the data generated from these programs can provide the basis for deriving estimates of the SIDS endpoint values for the remaining members of the component class.

Summary: No additional testing is planned.

Table 7. Alkadienes: Matrix of Available Data and Proposed Testing

Component CAS #	Propadiene 463-49-0	1,2-Butadiene 590-19-2	1,3-Butadiene 106-99-0	1,2-Pentadiene 591-95-7	1-cis-3-Pentadiene 1574-41-0	1-trans-3-Pentadiene 2004-70-8	1,4-Pentadiene 591-93-5	2,3-Pentadiene 591-96-8	1,2-Butadiene, 3-methyl 598-25-4	1,3-Butadiene, 2-methyl 78-79-5	Cyclo-pentadiene 542-92-7
Melting Point	To be interpolated/extrapolated from available and/or proposed data	To be interpolated/extrapolated from available and/or proposed data	OECD/SIDS Program	To be interpolated/extrapolated from available and/or proposed data	To be interpolated/extrapolated from available and/or proposed data	To be interpolated/extrapolated from available and/or proposed data	To be interpolated/extrapolated from available and/or proposed data	To be interpolated/extrapolated from available and/or proposed data	To be interpolated/extrapolated from available and/or proposed data	ACC Olefins Panel	To be interpolated/extrapolated from available and/or proposed data
Boiling Point											
Vapor Pressure											
Partition Coefficient											
Water Solubility											
Photodegradation											
Stability in Water											
Transport and Distribution											
Biodegradation											
Acute Toxicity to Fish											
Acute Toxicity to Aquatic Invertebrates											
Toxicity to Algae											
Acute Inhalation											
Repeated Dose											
Genotoxicity, bacterial											
Genotoxicity, *in vivo*											
Repro/Developmental											

Alkynes

As can be seen from Table 8 "Alkynes: Matrix of Available Data and Proposed Testing," the one alkyne component of petroleum gases is being considered under another test program.

Summary: No additional testing is planned.

Table 8. Alkynes: Matrix of Available Data and Proposed Testing

Component CAS #	Ethyne 74-86-2
Melting Point	
Boiling Point	
Vapor Pressure	
Partition Coefficient	
Water Solubility	
Photodegradation	
Stability in Water	
Transport and Distribution	
Biodegradation	
Acute Toxicity to Fish	
Acute Toxicity to Aquatic Invertebrates	
Toxicity to Algae	
Acute Inhalation	
Repeated Dose	
Genotoxicity, bacterial	
Genotoxicity, *in vivo*	
Repro/Developmental	

Aromatics

As can be seen from Table 9 "Aromatics: Matrix of Available Data and Proposed Testing," the Testing Group thinks the existing data is adequate with regard to the SIDS endpoints.

Summary: No additional testing is planned.

Table 9. Aromatics: Matrix of Available Data and Proposed Testing

Component CAS #	Benzene 71-43-2
Melting Point	
Boiling Point	
Vapor Pressure	ATSDR Toxicological Profile 1997
Partition Coefficient	
Water Solubility	
Photodegradation	
Stability in Water	
Transport and Distribution	
Biodegradation	
Acute Toxicity to Fish	
Acute Toxicity to Aquatic Invertebrates	OECD/SIDS Program
Toxicity to Algae	
Acute Inhalation	
Repeated Dose	
Genotoxicity, bacterial	
Genotoxicity, *in vivo*	
Repro/Developmental	

Mercaptans

As can be seen from Table 10 "Mercaptans: Matrix of Available Adequate Data and Proposed Testing," both mercaptan components found in petroleum gases are being considered under a complementary test program. The Testing Group anticipates that the data generated from this program will provide the basis for establishing the SIDS endpoint values for this component class.

Summary: No additional testing is planned.

Table 10. Mercaptans: Matrix of Available Data and Proposed Testing

Component CAS #	Methanethiol 74-93-1	Ethanethiol 75-08-1
Melting Point		
Boiling Point		
Vapor Pressure	Mercaptans/Thiols Council	Mercaptans/Thiols Council
Partition Coefficient		
Water Solubility		
Photodegradation		
Stability in Water		
Transport and Distribution		
Biodegradation		
Acute Toxicity to Fish		
Acute Toxicity to Aquatic Invertebrates		
Toxicity to Algae		
Acute Inhalation		
Repeated Dose		
Genotoxicity, bacterial		
Genotoxicity, *in vivo*		
Repro/Developmental		

Inorganics

As can be seen from Table 11 "Inorganics: Matrix of Available Data and Proposed Testing," the Testing Group thinks the existing data is adequate with regard to the SIDS endpoints.

Summary: No additional testing is planned.

Table 11. Inorganics: Matrix of Available Data and Proposed Testing

Component CAS #	Hydrogen 1333-74-0	Hydrogen sulfide 7783-06-4	Ammonia 7664-41-7	Nitrogen 7727-37-9	Carbon dioxide 124-38-9	Carbon monoxide 630-08-0
Melting Point						
Boiling Point						
Vapor Pressure						
Partition Coefficient						
Water Solubility						
Photodegradation	Adequate Data Available	ATSDR Toxicological Profile 1999	ATSDR Toxicological Profile 1990	Adequate Data Available	EPA Report: Carbon Dioxide as a Fire Suppressant	EPA Air Quality Criteria for Carbon Monoxide
Stability in Water						
Transport and Distribution						
Biodegradation						
Acute Toxicity to Fish						
Acute Toxicity to Aquatic Invertebrates						
Toxicity to Algae						
Acute Inhalation						
Repeated Dose						
Genotoxicity, bacterial						
Genotoxicity, in vivo						
Repro/Developmental						

EPA Report, *Carbon Dioxide as a Fire Suppressant: Examining the Risks;* EPA430-R-00-002, February 2000
EPA Report, Air Quality Criteria for Carbon Monoxide, EPA 600/P-99/001F, June 2000

Category Member

Liquefied Petroleum Gas (LPG)

The Testing Group will conduct more extensive testing on LPG than on the other test samples. The Testing Group thinks this more extensive testing of LPG is justified for two reasons:

1. in contrast to the other test samples, LPG is marketed to the general public, and
2. it addresses a request for data suitable for use in a human risk assessment done according to EU guidelines. The Testing Group predicts the testing of LPG included in this test plan will reduce the amount of overall testing and animal usage required to meet both U.S. HPV and EU requirements.

HEALTH EFFECTS

Acute Toxicity

LPG is predominantly propane, with lesser amounts of other C_3 and C_4 hydrocarbons. The Testing Group thinks the data available on human exposures to propane indicate LPG will not cause harmful effects at low concentrations. However, at very high concentrations, LPG can displace oxygen in the air and reduce the amount available for breathing, leading to asphyxiation (or suffocation) from lack of oxygen. Propane and butane can also have a mild depressant effect on the nervous system. Symptoms of overexposure to LPG can include shortness of breath, drowsiness, headaches, confusion, and decreased coordination. These symptoms are reversible if exposure is stopped. Exposure is rare at levels that produce these symptoms, since these levels also present an explosive hazard. Occupational exposure standards have been established by ACGIH for LPG based on asphyxiation and CNS effects.

The Testing Group thinks a sufficient amount of information exists regarding the acute effects of LPG.

Summary: No additional testing is planned.

***Repeated Dose* Toxicity**

No repeated dose studies have been conducted on LPG. Because LPG is one of the members (the other being methane) of this category with the greatest potential for exposure to the general public, the Testing Group is planning a 90-day repeat dose toxicity study. To reduce animal usage, a mammalian genetic toxicity study as well as neurotoxicity and reproductive evaluations will be incorporated into the 90-day repeated dose inhalation study, in lieu of conducting multiple studies to evaluate these endpoints separately.

Summary: LPG will be tested via inhalation using a 90-day repeated dose protocol (OECD Test Guideline 413). The study will include neurotoxicity evaluations and an intensive pathology examination of reproductive organs/tissues. A mammalian genetic toxicity study (OECD Test Guideline 474, micronucleus assay) will be incorporated into the 90-day repeated dose inhalation study.

In Vitro Genetic Toxicity

No in vitro genetic toxicity studies have been conducted on LPG.

The Testing Group considered the use of *in vitro* systems to test for chromosomal effects. However, the Testing Group decided against conducting these tests because:

1. The *in vitro* test system would need to be modified so that exposures would be done in culture flasks that could be dosed with the gas, then closed and kept sealed during the incubation period, meaning it would not be possible to expose to the gas and maintain exposure to 5% CO_2 in air. Bicarbonate buffers could be used to maintain pH in a reasonable range, but these culture conditions are not ideal for the cells.
2. Exposure of the cells to the gas would be limited because they would be attached to the substrate, under the surface of the culture medium, and most of the gas would stay in the air above the

medium. Exposure concentrations would be nominal, and would substantially overestimate the exposure concentrations experienced by the cells.

3. There is the possibility of an explosion hazard. First, because the incubators used for cell culture have temperature controls and wiring that can create sparks and second, because some gas will escape from the polystyrene culture flasks due to the flasks limited ability to contain gases.

Summary: LPG will be tested using the Ames Assay (OECD Test Guideline 471).

In Vivo Genetic Toxicity

No useable *in vivo* genetic toxicity data was identified. While the Testing Group shares the desire to limit animal testing by using ***in vitro*** methodologies when possible, it decided to conduct this test for the following reasons:

1. ***in vitro*** methodologies are not suited for studying volatile substances (as discussed above),
2. it could be performed using animals that were already included in tbe repeat dose 90-day inhalation study, and
3. it precludes the need to perform an additional study solely for the purpose studying ***in vivo*** genotoxicity.

Summary: LPG will be tested in a mammalian genetic toxicity study (OECD Test Guideline 474, micronucleus assay) incorporated into the 90-day repeated dose inhalation study.

Reproductive and Developmental Toxicity

No useable reproductive or developmental toxicity test data on LPG were identified. Because LPG is one of the members (the other being methane) of this category with the greatest potential for exposure to the general public, and to provide data for EU risk assessment considerations, the Testing Group is planning a more intensive protocol than used on the simple alkane components.

The Testing Group thinks its plan to address the reproductive toxicity endpoint for LPG by conducting in-depth pathology examinations of the reproductive organs of animals exposed during the 90-day repeat dose inhalation study is justified because:

1. LPG will also be tested for developmental toxicity,
2. reproductive/developmental toxicity screens will also be performed on the gases that are the major components of LPG,
3. a 2-generation reproductive toxicity study on a vapor recovery unit gasoline, composed of approximately 70% C_4 and C_5 hydrocarbons has already been performed (see Table 4),
4. the simple alkanes, the major components of LPG, have low toxicity and are not reactive, and
5. the data set will meet EU risk assessment considerations, thereby avoiding the need for additional testing.

Summary: LPG will be tested via inhalation exposures for developmental toxicity using the OECD Test Guideline 414 protocol. An in-depth pathology examination of reproductive organs from animals exposed to LPG during the 90-day inhalation study will address adverse reproductive potential.

PHYSICOCHEMICAL DATA

Available data on LPG can be found in the appropriate robust summary for these materials.

Summary: When measured values are not available from the literature, LPG values will be calculated as described in the EPA document titled, *The Use of Structure-Activity Relationships (SAR) in the High Production Volume Chemicals Challenge Program* (U.S. EPA, 1999a).

ENVIRONMENTAL/ECOTOXICITY DATA

Volatilization of the major components of LPG to the vapor phase in the ambient atmosphere and subsequent reaction with hydroxyl radicals is expected to be the most significant fate process. Calculated atmospheric half-lives for the components of LPG are in the appropriate robust summaries. Fugacity modeling supports the Testing Group's position that data on other environmental fate processes will either be much less or not relevant when assessing the

fate of these substances. Biodegradation and adsorption may occur in soil and water to a much lesser extent, but are not predominant behaviors for these gaseous components, due to atmospheric partitioning. Photolysis, hydrolysis and bioconcentration are not expected to be relevant environmental fate processes. Predictive computer models will be used to develop meaningful environmental fate data. Although there are some data for these substances, additional information will be prepared.

Photodegradation:
The quality of existing data for the photodegradation of the major components of LPG is inadequate.

Summary: Relevant atmospheric degradation data for the primary constituents of LPG will be calculated using the computer program AOPWIN (EPIWIN, 1999).

Stability in Water:
Hydrolysis is not a significant process, since hydrocarbons such as those that constitute LPG are not subject to hydrolysis reactions with water. Consequently, the use of tests (OECD Test Guideline 111 testing guideline) or computer models (HYDROWIN®) to determine stability in water is inappropriate (EPIWIN, 1999; U.S. EPA, 1999a; U.S. EPA, 1999b; Harris, 1982).

Summary: Hydrolysis testing and computer modeling will not be conducted for the primary constituents of LPG. Instead, a technical discussion on the potential for these constituents to hydrolyze will be prepared.

Chemical Transport and Distribution in the Environment:
A widely used fugacity model, the EQC (Equilibrium Criterion) model, Level I (Mackay et al., 1996) will be used to calculate distribution values for the major components of LPG. EPA cites the use of this model in its document titled *Determining the Adequacy of Existing Data* (U.S. EPA, 1999b). A computer model, EPIWIN - version 3.02 (EPIWIN, 1999), will be used to calculate the properties needed to run the Level I EQC model. After careful, in-depth review, the Testing Group decided that the use of the EQC Level III model is, at this time, an inappropriate approach to evaluating petroleum mixtures transport and distribution behavior. They reached this conclusion due to the lack of accurate emissions data and algorithms estimation limitations based on chemical specific properties.

Summary: Fugacity data for the major components of LPG will be calculated using the EQC Level I model.

Biodegradation:
Biodegradation of the primary gaseous components of LPG may occur in soil and water. Available data indicates that these gases are expected to be inherently biodegradable. Although the reliability of existing data for the biodegradation of the components of LPG (i.e., propane, butane, and isobutane) cannot be confirmed, biodegradability of this class of hydrocarbons, the paraffinics, has been extensively studied.

Summary: A technical discussion will be prepared describing degradation of these alkanes as reported in microbial metabolism research.

Ecotoxicity Data
Measured aquatic toxicity data do not exist for LPG. Given the water solubility and vapor pressure properties of the component gases, multimedia modeling predictions indicate that these gases will not partition into water and persist be present at concentrations where adverse effects would be expected to occur. Therefore, based on partitioning behavior, aquatic toxicity testing will not be conducted. In lieu of measured data, toxicity values will be calculated by ECOSAR analysis procedures using structure-activity relationships (SARs). Using the measured aquatic toxicity values and estimated K_{ow} values, regression equations can be developed for a class of chemicals. Toxicity values are then calculated by inserting the estimated K_{ow} into the regression equation and correcting the resultant value for the molecular weight of the compound. Most SAR calculations in the ECOSAR Class Program are based upon the octanol/water partition coefficient (K_{ow}). ECOSAR Class Program is a computerized version of the ECOSAR analysis procedures as currently practiced by the EPA Office of Pollution Prevention and Toxics. The estimated toxicity values for these gases may be considered reliable with restrictions, as these chemicals are not represented in

the ECOSAR program by test data for surrogate chemicals. An assessment of the aquatic toxicity of these gases will be prepared in the robust summaries based on an evaluation of predicted toxicity values, water solubility and partitioning behavior.

Summary: Fish, aquatic invertebrate, and alga toxicity studies will not be conducted. Instead, a technical discussion will be developed that addresses the physical nature of these substances as well as the fact that the primary compartment to which they will partition is the air. This statement will include a discussion of calculated aquatic toxicity data for propane, butane and isobutane. The calculated data will be developed using ECOSAR, a SAR program found in EPIWIN (EPIWIN, 1999).

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APPENDIX 1

Petroleum Gases Category Constituents by CAS No. [1,2]

CAS number

000074-82-8

Methane

No definition

(EU Category: Refinery Gases, Category 2)

000074-84-O

Ethane

No definition

(EU Category: Refinery Gases, Category 2)

000074-98-6

Propane, *liquefied C3H8*

No definition

(EU Category: Refinery Gases, Category 2)

000075-28-5

Propane, 2-methyl-

No definition

(EU Category: Refinery Gases, Category 2)

000078-78-4

Butane, 2-methyl

No definition

(EU Category: Refinery Gases, Category 2)

000106-97-8

Butane, pure C4H10

No definition

(EU Category: Refinery Gases, Category 2)

000109-66-O (not HPV listed)

Pentane

No definition

(EU Category: Refinery Gases, Category 2)

000115-07-1

1-Propene

No definition

(EU Category: Refinery Gases, Category 2)

000287-92-3

Cyclopentane

No definition

(EU Category: Refinery Gases, Category 2)

0005 13-35-g

2-Butene, 2-methy-

No definition

(EU Category: Refinery Gases, Category 2)

008006-14-2

Natural gas

Raw natural gas, as found in nature, or a gaseous combination of hydrocarbons having carbon numbers predominantly in the range of Cl through C4 separated from raw natural gas by the removal of natural gas condensate, natural gas liquid, and natural gas condensate/natural gas.

(EU Category: Refinery Gases, Category 2)

068131-75-g

Gases (petroleum), C3-4

A complex combination of hydrocarbons produced by distillation of products from the cracking of crude oil. It consists of hydrocarbons having carbon numbers in the range of C3 through C4, predominantly of propane and propylene, and boiling in the range of

approximately -51°C to -1°C (-60°F to 30°F).
(EU Category: Refinery Gases, Category 2)

068307-98-2

Tail gas (petroleum), catalytic cracked distillate and catalytic cracked naphtha fractionation absorber.

The complex combination of hydrocarbons from the distillation of the products from catalytic cracked distillates and catalytic cracked naphtha. It consists predominantly of hydrocarbons having carbon numbers in the range of C 1 through C4.
(EU Category: Refinery Gases, Category 2)

068307-99-3 (not HPV listed)

Tail gas (petroleum), catalytic polymn. naphtha fractionation stabilizer

A complex combination of hydrocarbons from the fractionation stabilization products from polymerization of naphtha. It consists predominantly of hydrocarbons having carbon numbers in the range of C 1 through C4.
(EU Category: Refinery Gases, Category 2)

068308-02-l (not HPV listed)

Tail gas (petroleum), distn., hydrogen sulfide-free

No definition
(EU Category: Refinery Gases, Category 2)

068308-03-2

Tail gas (petroleum), gas oil catalytic cracking absorber

A complex combination of hydrocarbons obtained from the distillation of products from the catalytic cracking of gas oil. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of Cl through C5.
(EU Category: Refinery Gases, Category 2)

068308-04-3

Tail gas (petroleum), gas recovery plant

A complex combination of hydrocarbons from the distillation of products from miscellaneous hydrocarbon streams. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of Cl through C5.
(EU Category: Refinery Gases, Category 2)

068308-05-4

Tail gas (petroleum), gas recovery plant deethanizer

A complex combination of hydrocarbons from the distillation of products from miscellaneous hydrocarbon streams. It consists of hydrocarbon having carbon numbers predominantly in the range of Cl through C4.
(EU Category: Refinery Gases, Category 2)

068308-06-5

Tail gas (petroleum), hydrodesuljurized distillate and hydrodesulfurized naphtha fractionator, acid-free

A complex combination of hydrocarbons obtained from fractionation of hydrodesulfurized naphtha and distillate hydrocarbon streams and treated to remove acidic impurities. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C 1 through C5.
(EU Category: Refinery Gases, Category 2)

068308-08-7

Tail gas (petroleum), isomerized naphtha fractionation stabilizer

A complex combination of hydrocarbons obtained from the fractionation stabilization products from isomerized naphtha. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C 1 through C4.
(EU Category: Refinery Gases, Category 2)

068308-09-8 (not HPV listed)

Tail gas (petroleum), light straight-run naphtha stabilizer, hydrogen sulfide-free

A complex combination of hydrocarbons obtained from fractionation stabilization of light straight run naphtha and from which hydrogen sulfide has been removed by amine treatment. It consists predominantly of hydrocarbons having carbon numbers

predominantly in the range of C 1 through C5.
(EU Category: Refinery Gases, Category 2)

068308-10-l

Tail gas (petroleum), straight run distillate hydrodesulfurizer, H2S free

A complex combination of hydrocarbons obtained from catalytic hydrodesulfurization of straight run distillates and from which hydrogen sulfide has been removed by amine treatment. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of Cl through C4.
(EU Category: Refinery Gases, Category 2)

068308-l l-2

Tail gas (petroleum), propane-propylene alkylation feed prep deethanizer

A complex combination of hydrocarbons obtained from the distillation of the reaction products of propane with propylene. It consists of hydrocarbons having carbon numbers predominantly in the range of C 1 through C4.
(EU Category: Refinery Gases, Category 2)

068308-12-3

Tail gas (petroleum), vacuum gas oil hydrodesulfurizer, hydrogen sulfide-free

A complex combination of hydrocarbons obtained from catalytic hydrodesulfurization of vacuum gas oil and from which hydrogen sulfide has been removed by amine treatment. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of Cl through C6.
(EU Category: Refinery Gases, Category 2)

068308-27-o

Fuel gases, refinery

A complex combination of light gases consisting of hydrogen and hydrocarbons having carbon numbers predominantly in the range of Cl through C5.
(EU Category: Refinery Gases, Category 2)

068409-99-4

Gases (petroleum), catalytic cracked overheads

A complex combination of hydrocarbons produced by the distillation of products from the catalytic cracking process. It consists of hydrocarbons having carbon numbers predominantly in the range of C3 through C5 and boiling in the range of approximately -48°C to 32°C (-54°F to 90°F).
(EU Category: Refinery Gases, Category 2)

068410-63-g

Natural gas, dried

A complex combination of hydrocarbons separated from natural gas. It consists of saturated aliphatic hydrocarbons having carbon numbers in the range of Cl through C4, predominantly methane and ethane.
(EU Category: Refinery Gases, Category 2)

068475-57-o (not HPV listed)

Alkanes, Cl -2

No definition
(EU Category: Refinery Gases, Category 2)

068475-58-1

Alkanes, C2-3

No definition
(EU Category: Refinery Gases, Category 2)

068475-59-2

Alkanes, C3-4

No definition
(EU Category: Refinery Gases, Category 2)

068475-60-5

Alkanes, C4-5

No definition
(EU Category: Refinery Gases, Category 2)

068476-26-6

Fuel gases

A combination of light gases. It consists predominantly of hydrogen and/or low molecular weight hydrocarbons.

(EU Category: Refinery Gases, Category 2)

068476-27-7

Fuel gases, amine system residues

The complex residuum from the amine system for removal of hydrogen sulfide. It consists primarily of hydrogen, methane and ethane with various small amounts of nitrogen, carbon dioxide and hydrocarbons having carbon numbers predominantly in the range of C3 through C5.

(EU Category: Refinery Gases, Category 2)

068476-28-g

Fuel gases, C6-8 catalytic reformer

A complex combination of gases obtained from a catalytic reforming process using C6-8 hydrocarbon feed. It consists primarily of hydrogen and methane with various small amounts of nitrogen, carbon monoxide, carbon dioxide and hydrocarbons having carbon numbers predominantly in the range of C2 through C6.

(EU Category: Refinery Gases, Category 2)

068476-29-g

Fuel gases, crude oil distillates

A complex combination of light gases produced by distillation of crude oil and by catalytic reforming of naphtha. It consists of hydrogen and hydrocarbons having carbon numbers predominantly in the range of Cl through C4 and boiling in the range of approximately -217°C to -12°C (-423°F to 10°F).

(EU Category: Refinery Gases, Category 2)

068476-40-4

Hydrocarbons, C3-4

No definition

(EU Category: Refinery Gases, Category 2)

068476-42-6

Hydrocarbons, C4-5

No definition

(EU Category: Refinery Gases, Category 2)

068476-44-g

Hydrocarbons, C4 and higher

No definition

(EU Category: Refinery Gases, Category 2)

068476-49-3

Hydrocarbons, C2-4, C3-rich

No definition

(EU Category: Refinery Gases, Category 2)

068476-54-o

Hydrocarbons, C3-5, polymn. unit feed

A complex combination of hydrocarbons collected from various processes. It consists predominantly of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C3 to C5 and boiling in the range of approximately -48°C to 38 °C (-54°F to 100°F).

(EU Category: Refinery Gases, Category 2)

068476-85-7

Petroleum gases, liquefied

A complex combination of hydrocarbons produced by the distillation of crude oil. It consists of hydrocarbons having carbon numbers predominantly in the range of C3 through

C7 and boiling in the range of approximately -40°C to 80°C (-40°F to 176°F).
(EU Category: Refinery Gases, Category 2)

068476-86-g

Petroleum gases, liquefied, sweetened

A complex combination of hydrocarbons obtained by subjecting liquefied petroleum gas mix to a sweetening process to convert mercaptans or to remove acidic impurities. It consists of hydrocarbons having carbon numbers predominantly in the range of C3 through C7 and boiling in the range of approximately -40°C to 80°C (-40°F to 176°F).
(EU Category: Refinery Gases, Category 2)

068477-25-g

Waste gases, vent gas, Cl -6

A complex combination of hydrocarbons produced by the distillation of products from the vacuum unit. It consists of saturated hydrocarbons having carbon numbers in the range of C 1 through C6.
(EU Category: Refinery Gases, Category 2)

068477-33-g

Gases (petroleum), C3-4, isobutane-rich

A complex combination of hydrocarbons from the distillation of saturated and unsaturated hydrocarbons usually ranging in carbon numbers from C3 through C6, predominantly butane and isobutane. It consists of saturated and unsaturated hydrocarbons having carbon numbers in the range of C3 through C4, predominantly isobutane.
(EU Category: Refinery Gases, Category 2)

068477-42-9

Gases (petroleum), extractive, C3-5, butene-isobutylene-rich

A complex combination of hydrocarbons obtained from extractive distillation of saturated and unsaturated aliphatic hydrocarbons usually ranging in carbon numbers from C3 through C5, predominantly C4. It consists of saturated and unsaturated hydrocarbons having carbon numbers predominantly in the range of C3 through C5, predominantly butenes and isobutylene.
(EU Category: Refinery Gases, Category 2)

068477-69-o

Gases (petroleum), butane splitter overheads

A complex combination of hydrocarbons obtained from the distillation of the butane stream. It consists of aliphatic hydrocarbons having carbon numbers predominantly in the range of C3 through C4.
(EU Category: Refinery Gases, Category 2)

068477-70-3

Gases (petroleum), C2-3

A complex combination of hydrocarbons produced by the distillation of products from a catalytic fractionation process. It contains predominantly ethane, ethylene, propane, and propylene.
(EU Category: Refinery Gases, Category 2)

068477-7 1-4

Gases (petroleum), catalytic-cracked gas oil depropanizer bottoms, C4-rich acid-free

A complex combination of hydrocarbons obtained from fractionation of catalytic cracked gas oil hydrocarbon stream and treated to remove hydrogen sulfide and other acidic components. It consists of hydrocarbons having carbon numbers in the range of C3 through C5, predominantly C4.
(EU Category: Refinery Gases, Category 2)

068477-72-5

Gases (petroleum}, catalytic-cracked naphtha debutanizer bottoms, C3-5-rich

A complex combination of hydrocarbons obtained from the stabilization of catalytic cracked naphtha. It consists of aliphatic hydrocarbons having carbon numbers predominantly in the range of C3 through C5.

(EU Category: Refinery Gases, Category 2)

068477-73-6

Gases (petroleum), catalytic cracked naphtha depropanizer overhead, C3-rich acid-free

A complex combination of hydrocarbons obtained from fractionation of catalytic cracked hydrocarbons and treated to remove acidic impurities. It consists of hydrocarbons having carbon numbers in the range of C2 through C4, predominantly C3.

(EU Category: Refinery Gases, Category 2)

068477-74-7

Gases (petroleum), catalytic cracker

A complex combination of hydrocarbons produced by the distillation of the products from a catalytic cracking process. It consists predominantly of aliphatic hydrocarbons having carbon numbers predominantly in the range of Cl through C6.

(EU Category: Refinery Gases, Category 2)

068477-75-g

Gases (petroleum), catalytic cracker, Cl -5-rich

A complex combination of hydrocarbons produced by the distillation of products from a catalytic cracking process. It consists of aliphatic hydrocarbons having carbon numbers in the range of Cl through C6, predominantly Cl through C5.

(EU Category: Refinery Gases, Category 2)

068477-76-9 (not HPV listed)

Gases (petroleum), catalytic polymd. naphtha stabilizer overhead, C2-4-rich

A complex combination of hydrocarbons obtained from the fractionation stabilization of catalytic polymerized naphtha. It consists of aliphatic hydrocarbons having carbon numbers in the range of C2 through C6, predominantly C2 through C4.

(EU Category: Refinery Gases, Category 2)

068477-79-2

Gases (petroleum), catalytic reformer, Cl-4-rich

A complex combination of hydrocarbons produced by distillation of products from a catalytic reforming process. It consists of hydrocarbons having carbon numbers in the range of Cl through C6, predominantly Cl through C4.

(EU Category: Refinery Gases, Category 2)

068477-83-g

Gases (petroleum), C3-5 olefinic-paraffinic alkylation feed

A complex combination of olefinic and paraffinic hydrocarbons having carbon numbers in the range of C3 through C5 which are used as alkylation feed. Ambient temperatures normally exceed the critical temperature of these combinations.

(EU Category: Refinery Gases, Category 2)

068477-85-o

Gases (petroleum), C4-rich

A complex combination of hydrocarbons produced by distillation of products from a catalytic fractionation process. It consists of aliphatic hydrocarbons having carbon numbers in the range of C3 through C5, predominantly C4.

(EU Category: Refinery Gases, Category 2)

068477-86-1

Gases ***(petroleum), deethanizer overheads***

A complex combination of hydrocarbons produced from distillation of the gas and gasoline fractions from the catalytic cracking process. It contains predominantly ethane and ethylene.

(EU Category: Refinery Gases, Category 2)

068477-87-2

Gases (petroleum), deisobutanizer tower overheads

A complex combination of hydrocarbons produced by the atmospheric distillation of a butane-butylene stream. It consists of aliphatic hydrocarbons having carbon numbers predominantly in the range of C3 through C4.

(EU Category: Refinery Gases, Category 2)

068477-88-3

Gases (petroleum), deethanizer overheads, C3-rich

A complex combination of hydrocarbons produced by distillation of products from the propylene purification unit. It consists of aliphatic hydrocarbons having carbon numbers in the range of Cl through C3, predominantly C3.

(EU Category: Refinery Gases, Category 2)

068477-90-7

Gases (petroleum), depropanizer dry, propene-rich

A complex combination of hydrocarbons produced by the distillation of products from the gas and gasoline fractions of a catalytic cracking process. It consists predominantly of propylene with some ethane and propane.

(EU Category: Refinery Gases, Category 2)

068477-91-8

Gases (petroleum), depropanizer overheads

A complex combination of hydrocarbons produced by distillation of products from the gas and gasoline fractions of a catalytic cracking process. It consists of aliphatic hydrocarbons having carbon numbers predominantly in the range of C2 through C4.

(EU Category: Refinery Gases, Category 2)

068477-94-1

Gases (petroleum), gas recovery plant depropanizer overheads

A complex combination of hydrocarbons obtained by fractionation of miscellaneous hydrocarbon streams. It consists predominantly of hydrocarbons having carbon numbers in the range of Cl through C4, predominantly propane.

(EU Category: Refinery Gases, Category 2)

068477-95-2

Gases (petroleum), Girbatol unit feed

A complex combination of hydrocarbons that is used as the feed into the Girbatol unit to remove hydrogen sulfide. It consists of aliphatic hydrocarbons having carbon numbers predominantly in the range of C2 through C4.

(EU Category: Refinery Gases, Category 2)

068478-19-3

Residual oils (petroleum), propene purifn. splitter

A complex residuum from the propene purification unit. It consists of aliphatic hydrocarbons having carbon numbers predominantly in the range of C3 through C4.

(EU Category: Refinery Gases, Category 2)

068478-24-o

Tail gas (petroleum), catalytic cracker, catalytic reformer and hydrodesulfurizer combined fractionater

A complex combination of hydrocarbons obtained from the fractionation of products from catalytic cracking, catalytic reforming and hydrodesulfurizing processes treated to remove acidic impurities. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C 1 through C.5.

(EU Category: Refinery Gases, Category 2)

068478-26-2

Tail gas (petroleum), catalytic reformed naphtha fractionation stabilizer

A complex combination of hydrocarbons obtained from the fractionation stabilization of catalytic reformed naphtha. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of Cl through C4.

(EU Category: Refinery Gases, Category 2)

068478-32-o

Tail gas (petroleum), saturate gas plant mixed stream, C4-rich

A complex combination of hydrocarbons obtained from the fractionation stabilization of straight-run naphtha, distillation tail gas and catalytic reformed naphtha stabilizer tail gas. It consists of hydrocarbons having carbon numbers in the range of C3 through C6, predominantly butane and isobutane.

(EU Category: Refinery Gases, Category 2)

068478-33-l

Tail gas {petroleum), saturate gas recovery plant, Cl-2-rich

A complex combination of hydrocarbons obtained from fractionation of distillate tail gas, straight-run naphtha, catalytic reformed naphtha stabilizer tail gas. It consists predominantly of hydrocarbons having carbon numbers in the range of C 1 through C5, predominantly methane and ethane.

(EU Category: Refinery Gases, Category 2)

068478-34-2

Tail gas (petroleum), vacuum residues thermal cracker

A complex combination of hydrocarbons obtained from the thermal cracking of vacuum residues. It consists of hydrocarbons having carbon numbers predominantly in the range of Cl through C5.

(EU Category: Refinery Gases, Category 2)

068512-91-4

Hydrocarbons, C3-4-rich, petroleum distillate

A complex combination of hydrocarbons produced by distillation and condensation of crude oil. It consists of hydrocarbons having carbon numbers in the range of C3 through C5, predominantly C3 through C4.

(EU Category: Refinery Gases, Category 2)

068513-11-l

Fuel gases, hydrotreater fractionation, scrubbed

A complex combination produced by the fractionation and scrubbing of products from various hydrotreating units. It consists of hydrogen and hydrocarbons having carbon numbers predominantly in the range of Cl through C4.

(EU Category: Refinery Gases, Category 2)

068513-12-2

Fuel gases, saturate gas unitfractionater-absorber overheads

A complex combination produced by the fractionation and absorption of products of the saturate gas unit. It consists of hydrogen and saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of Cl through C4.

(EU Category: Refinery Gases, Category 2)

068513-13-3

Fuel gases, thermal cracked catalytic cracking residue

A complex combination obtained by the thermal cracking of a catalytically cracked residuum. It consists of hydrogen and saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of Cl through C4.

(EU Category: Refinery Gases, Category 2)

068513-15-5

Gases (petroleum), full-range straight-run naphtha dehexanizer off

A complex combination of hydrocarbons obtained by the fractionation of the full-range straight-run naphtha. It consists of hydrocarbons having carbon numbers predominantly in the range of C2 through C6.

(EU Category: Refinery Gases, Category 2)

068513-16-6

Gases (petroleum), hydrocracking depropanizer off, hydrocarbon-rich

A complex combination of hydrocarbon produced by the distillation of products from a hydrocracking process. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of Cl through C4. It may also contain small amounts of hydrogen and hydrogen sulfide.

(EU Category: Refinery Gases, Category 2)

068513-17-7

Gases (petroleum), light straight-run naphtha stabilizer off

A complex combination of hydrocarbons obtained by the stabilization of light straight-run naphtha. It consists of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C2 through C6.

(EU Category: Refinery Gases, Category 2)

0685 13-65-5

Butane, branched and linear

No definition

(EU Category: Refinery Gases, Category 2)

0685 13-66-6

Residues (petroleum), alkylation splitter, C4-rich

A complex residuum from the distillation of streams from various refinery operations. It consists of hydrocarbons having carbon numbers in the range of C4 through C5, predominantly butane and boiling in the range of approximately -11.7°C to 27.8°C (11°F to 82°F).

(EU Category: Refinery Gases, Category 2)

068514-31-g

Hydrocarbons, Cl -4

A complex combination of hydrocarbons produced by thermal cracking and absorber operations and by distillation of crude oil. It consists of hydrocarbons having carbon numbers predominantly in the range of C 1 through C4 and boiling in the range of approximately ▪ 164°C to ▪ 5°C (-263°F to 3 1 "F).

(EU Category: Refinery Gases, Category 2)

0685 14-36-3

Hydrocarbons, Cl-4, sweetened

A complex combination of hydrocarbons obtained by subjecting hydrocarbon gases to a sweetening process to convert mercaptans or to remove acidic impurities. It consists of hydrocarbons having carbon numbers predominantly in the range of Cl through C4 and boiling in the range of approximately ▪ 164°C to -0.5°C (-263°F to 3 1 "F).

(EU Category: Refinery Gases, Category 2)

068527-14-o (not HPV listed)

Gases (petroleum), methane-rich off ..C1

A complex combination separated by distillation of a gas stream containing hydrogen, carbon monoxide, carbon dioxide and hydrocarbons having carbon numbers in the range of C 1 through C6 or obtained by the cracking of ethane and propane. It consists primarily of methane with various small amounts of hydrogen and nitrogen.

(EU Category: Refinery Gases, Category 2)

068527-16-2

Hydrocarbons, Cl -3

A complex combination of hydrocarbons having carbon numbers predominantly in the range of Cl through C3 and boiling in the range of approximately minus 164°C to -42°C (-263°F to -44°F).

(EU Category: Refinery Gases, Category 2)

068527-19-5

Hydrocarbons, C1-4, debutanizerfraction

No definition

(EU Category: Refinery Gases, Category 2)

068602-83-5

Gases (petroleum), Cl -5, wet

A complex combination of hydrocarbons produced by the distillation of crude oil and/or the cracking of tower gas oil. It consists of hydrocarbons having carbon numbers predominantly in the range of Cl through C5.

(EU Category: Refinery Gases, Category 2)

068606-24-6

Hydrocarbons, C4, butene concentrator by-product

A complex combination of hydrocarbons obtained in the production of butene concentrate. It consists of hydrocarbons having carbon numbers predominantly in the range of C3 through C5.

(EU Category: Refinery Gases, Category 2)

068606-25-7

Hydrocarbons, C2-4

No definition

(EU Category: Refinery Gases, Category 2)

068606-26-B

Hydrocarbons, C3

No definition

(EU Category: Refinery Gases, Category 2)

068606-27-g

Gases (petroleum), alkylation feed

A complex combination of hydrocarbons produced by the catalytic cracking of gas oil. It consists of hydrocarbons having carbon numbers predominantly in the range of C3 through ***c4.***

(EU Category: Refinery Gases, Category 2)

068606-34-B

Gases (petroleum), depropanizer bottoms fractionation off

A complex combination of hydrocarbons obtained from the fractionation of depropanizer bottoms. It consists predominantly of butane, isobutane and butadiene.

(EU Category: Refinery Gases, Category 2)

068783-07-3

Gases (petroleum), refinery blend

A complex combination obtained from various refinery processes. It consists of hydrogen, hydrogen sulfide and hydrocarbons having carbon numbers predominantly in the range of C 1 through C5.

(EU Category: Refinery Gases, Category 2)

068783-61-g

Fuel gases, refinery, sweetened

A complex combination obtained by subjecting refinery fuel gases to a sweetening process to convert mercaptans or to remove acidic impurities. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of Cl through C5 and boiling in the range of approximately -73°C to 50°C (-100°F to 122°F).

(EU Category: Refinery Gases, Category 2)

068783-62-o

Fuel gases, refinery, unsweetened

A complex combination obtained by the fractionation of naphtha and compressed hydrocarbon gas streams from various refinery processes. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C 1 through C5 and boiling in the range of -73°C to 65°C (-100°F to 150°F).

(EU Category: Refinery Gases, Category 2)

068783-64-2

Gases (petroleum), catalytic cracking

A complex combination of hydrocarbons produced by the distillation of the products from a catalytic cracking process. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C3 through C5.

(EU Category: Refinery Gases, Category 2)

068783-65-3

Gases (petroleum), C2-4, sweetened

A complex combination of hydrocarbons obtained by subjecting a petroleum distillate to a sweetening process to convert mercaptans or to remove acidic impurities. It consists predominantly of saturated and unsaturated hydrocarbons having carbon numbers predominantly in the range of C2 through C4 and boiling in the range of approximately -51°C to -34°C (-60°F to -30°F).

(EU Category: Refinery Gases, Category 2)

068814-47-1

Waste gases, rejinery vent

A complex combination obtained from various refinery processes. It consists of hydrocarbons having carbon numbers predominantly in the range of Cl through C5 and hydrogen sulfide.

(EU Category: Refinery Gases, Category 2)

068918-98-g

Fuel gases, refinery, hydrogen sulfide-free

A complex combination of light gases consisting of hydrocarbons having carbon numbers predominantly in the range of Cl through C3. Produced from the fractionation and subsequent scrubbing of hydrotreating units.

(EU Category: Refinery Gases, Category 2)

068918-99-o

Gases (petroleum), crude oil fractionation off

A complex combination of hydrocarbons produced by the fractionation of crude oil. It consists of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of Cl through C5.

(EU Category: Refinery Gases, Category 2)

068919-00-6 (not HPV listed)

Gas (petroleum), dehexanizer off

A complex combination of hydrocarbons obtained by the fractionation of combined naphtha streams. It consists of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C 1 through C5.

(EU Category: Refinery Gases, Category 2)

068919-05-l

Gases (petroleum), light straight run gasoline fractionation stabilizer off

A complex combination of hydrocarbons obtained by the fractionation of light straight-run gasoline. It consists of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of Cl through C5.

(EU Category: Refinery Gases, Category 2)

068919-06-2

Gases (petroleum), naphtha unifiner desulfurization stripper off

A complex combination of hydrocarbons produced by a naphtha unifiner desulfurization process and stripped from the naphtha product. It consists of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of Cl through C4.

(EU Category: Refinery Gases, Category 2)

068919-10-S

Gases (petroleum), straight-run stabilizer off

A complex combination of hydrocarbons obtained from the fractionation of the liquid from the first tower used in the distillation of crude oil. It consists of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of Cl through C4.

(EU Category: Refinery Gases, Category 2)

068919-16-4

Hydrocarbons, C3-6, catalytic alkylation by-products

The complex combination of hydrocarbons obtained by the catalytic alkylation of benzene with propylene. It consists of hydrocarbons having carbon numbers predominantly in the range of C3 through C6 and boiling in the range of approximately -40°C to 70°C (-40°F to 158°F). This stream may contain 1 to 20 vol. % of benzene.

(EU Category: Refinery Gases, Category 2)

068919-19-7

Gases {petroleum), jluidized catalytic cracker splitter residues

A complex combination of hydrocarbons produced by the fractionation of the charge to the C3-C4 splitter. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C3 through C4.

(EU Category: Refinery Gases, Category 2)

068919-20-o

Gases (petroleum), fluidized catalytic cracker splitter overheads

A complex combination of hydrocarbons produced by the fractionation of the charge to the C3-C4 splitter. It consists predominantly of C3 hydrocarbons.

(EU Category: Refinery Gases, Category 2)

068952-76-1

Gases (petroleum), catalytic cracked naphtha debutanizer

A complex combination of hydrocarbons obtained from fractionation of catalytic cracked naphtha. It consists of hydrocarbons having carbon numbers predominantly in the range of Cl through c4.
(EU Category: Refinery Gases, Category 2)

068952-81-8

Tail gas (petroleum), thermal-cracked distillate, gas oil and naphtha absorber

A complex combination of hydrocarbons obtained from the separation of thermal-cracked distillates, naphtha and gas oil. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of Cl through C6.
(EU Category: Refinery Gases, Category 2)

068952-82-g

Tail gas (petroleum), thermal cracked hydrocarbon fractionation stabilizer, petroleum coking

A complex combination of hydrocarbons obtained from the fractionation stabilization of thermal cracked hydrocarbons from petroleum coking process. It consists of hydrocarbons having carbon numbers predominantly in the range of Cl through C6.
(EU Category: Refinery Gases, Category 2)

068955-28-2

Gases (petroleum), light steam-cracked, butadiene conc.

A complex combination of hydrocarbons produced by the distillation of products from a thermal cracking process. It consists of hydrocarbons having a carbon number predominantly of C4.
(EU Category: Refinery Gases, Category 2)

068955-34-o

Gases (petroleum), straight-run naphtha catalytic reformer stabilizer overhead

A complex combination of hydrocarbons obtained by the catalytic reforming of straight-run naphtha and the fractionation of the total effluent. It consists of saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C2.
(EU Category: Refinery Gases, Category 2)

068956-54-7

Hydrocarbons, C4-unsatd.

No definition
(EU Category: Refinery Gases, Category 2)

071329-37-8

Residues (petroleum), catalytic cracking depropanizer, C4-rich

A complex residuum from the stabilization of catalytic cracked naphtha hydrocarbon streams. It consists predominantly of hydrocarbons having carbon numbers predominantly in the range of C3 through C5, primarily C4.
(EU Category: Refinery Gases, Category 2)

07 1808-30-5

Tail gas (petroleum), thermal cracking absorber

A complex combination of hydrocarbons obtained from the separation of thermal cracked naphtha, distillates and gas oil hydrocarbons. It consists of hydrocarbons having carbon numbers predominantly in the range of Cl through C5.
(EU Category: Refinery Gases, Category 2)

008006-20-O

Fuel gases. Low and medium BTU

A complex combination obtained by burning coal or coke with a restricted air or oxygen supply or by blowing air or oxygen and steam through incandescent coke. The combustibles consist primarily of carbon monoxide, carbon dioxide and hydrogen.
(EU Category: Refinery Gases, Category 35)

068477-65-6

Gases (petroleum), amine system feed

The feed to the amine system for removal of hydrogen sulfide. It consists of hydrogen, carbon monoxide, carbon dioxide, hydrogen sulfide and aliphatic hydrocarbons having carbon numbers predominantly in the range of Cl through C5.

(EU Category: Refinery Gases, Category 35)

068477-66-7

Gases (petroleum), benzene unit hydrodesulfurizer off

Off gases produced by the benzene unit. It consists primarily of hydrogen. Carbon monoxide and hydrocarbons having carbon numbers predominantly in the range of C 1 through C6, including benzene, may also be present.

(EU Category: Refinery Gases, Category 35)

068477-67-g

Gases (petroleum), benzene unit recycle, hydrogen-rich

A complex combination of hydrocarbons obtained by recycling the gases of the benzene unit. It consists primarily of hydrogen with various small amounts of carbon monoxide and hydrocarbons having carbon numbers in the range of Cl through C6.

(EU Category: Refinery Gases, Category 35)

068477-68-9

Gases (petroleum), blend oil, hydrogen-nitrogen-rich

A complex combination of hydrocarbons obtained by distillation of a blend oil. It consists primarily of hydrogen and nitrogen with various small amounts of carbon monoxide, carbon dioxide, and aliphatic hydrocarbons having carbon numbers predominantly in the range of Cl through C5.

(EU Category: Refinery Gases, Category 35)

068477-77-o

Gases (petroleum), catalytic reformed naphtha stripper overheads

A complex combination of hydrocarbons obtained from the stabilization of catalytic reformed naphtha. It consists of hydrogen and saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C 1 through C4.

(EU Category: Refinery Gases, Category 35)

068477-80-5

Gases (petroleum), C6-8 catalytic reformer recycle

A complex combination of hydrocarbons produced by distillation of products from catalytic reforming of C6-C8 feed and recycled to conserve hydrogen. It consists primarily of hydrogen. It may also contain various small amounts of carbon monoxide, carbon dioxide, nitrogen, and hydrocarbons having carbon numbers predominantly in the range of Cl through C6.

(EU Category: Refinery Gases, Category 35)

068477-g l-6

Gases (petroleum), C6-8 catalytic reformer

A complex combination of hydrocarbons produced by distillation of products from catalytic reforming of C6-C8 feed. It consists of hydrocarbons having carbon numbers in the range of Cl through C5 and hydrogen.

(EU Category: Refinery Gases, Category 35)

068477-82-7

Gases (petroleum), C6-8 catalytic reformer recycle, hydrogen-rich

No definition

(EU Category: Refinery Gases, Category 35)

068477-92-9

Gases (petroleum), dry sour, gas-concn. -unit-off

The complex combination of dry gases from a gas concentration unit. It consists of hydrogen, hydrogen sulfide and hydrocarbons having carbon numbers predominantly in the range of Cl through C3.

(EU Category: Refinery Gases, Category 35)

068477-97-4

Gases (petroleum), hydrogen-rich

A complex combination separated as a gas from hydrocarbon gases by chilling. It consists primarily of hydrogen with various small amounts of carbon monoxide, nitrogen, methane, and C2 hydrocarbons.

(EU Category: Refinery Gases, Category 3.5)

068477-98-5

Gases (petroleum), hydrotreater blend oil recycle, hydrogen-nitrogen-rich

A complex combination obtained from recycled hydrotreated blend oil. It consists primarily of hydrogen and nitrogen with various small amounts of carbon monoxide, carbon dioxide and hydrocarbons having carbon numbers predominantly in the range of Cl through C5.

(EU Category: Refinery Gases, Category 35)

068478-00-2

Gases (petroleum), recycle, hydrogen-rich

A complex combination obtained from recycled reactor gases. It consists primarily of hydrogen with various small amounts of carbon monoxide, carbon dioxide, nitrogen, hydrogen sulfide, and saturated aliphatic hydrocarbons having carbon numbers in the range of C l through C5.

(EU Category: Refinery Gases, Category 35)

068478-01-3

Gases (petroleum), reformer make-up, hydrogen-rich

A complex combination obtained from the reformers. It consists primarily of hydrogen with various small amounts of carbon monoxide and aliphatic hydrocarbons having carbon numbers predominantly in the range of C 1 through C5.

(EU Category: Refinery Gases, Category 35)

068478-02-4

Gases (petroleum), reforming hydrotreater

A complex combination obtained from the reforming hydrotreating process. It consists primarily of hydrogen, methane, and ethane with various small amounts of hydrogen sulfide and aliphatic hydrocarbons having carbon numbers predominantly in the range of C3 through C5.

(EU Category: Refinery Gases, Category 35)

068478-03-5

Gases (petroleum), reforming hydrotreater, hydrogen-methane-rich

A complex combination obtained from the reforming hydrotreating process. It consists primarily of hydrogen and methane with various small amounts of carbon monoxide, carbon dioxide, nitrogen and saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C2 through C5.

(EU Category: Refinery Gases, Category 35)

068478-04-6

Gases (petroleum), reforming hydrotreater make-up, hydrogen-rich

A complex combination obtained from the reforming hydrotreating process. It consists primarily of hydrogen with various small amounts of carbon monoxide and aliphatic hydrocarbons having carbon numbers predominantly in the range of C 1 through C5.

(EU Category: Refinery Gases, Category 35)

068478-05-7

Gases (petroleum), thermal cracking distn.

A complex combination produced by distillation of products from a thermal cracking process. It consists of hydrogen, hydrogen sulfide, carbon monoxide, carbon dioxide and hydrocarbons having carbon numbers predominantly in the range of Cl through C6.

(EU Category: Refinery Gases, Category 35)

068478-25-l

Tail gas (petroleum}, catalytic cracker refractionation absorber

A complex combination of hydrocarbons obtained from refractionation of products from a catalytic cracking process. It consists of hydrogen and hydrocarbons having carbon numbers predominantly in the range of C 1 through C3.

(EU Category: Refinery Gases, Category 35)

068478-27-3

Tail gas (petroleum), catalytic reformed naphtha separator

A complex combination of hydrocarbons obtained from the catalytic reforming of straight

run naphtha. It consists of hydrogen and hydrocarbons having carbon numbers predominantly in the range of Cl through C6.
(EU Category: Refinery Gases, Category 35)

068478-28-4

Tail gas (petroleum), catalytic reformed naphtha stabilizer

A complex combination of hydrocarbons obtained from the stabilization of catalytic reformed naphtha. It consists of hydrogen and hydrocarbons having carbon numbers predominantly in the range of C 1 through C6.
(EU Category: Refinery Gases, Category 35)

068478-29-S

Tail gas (petroleum), cracked distillate hydrotreater separator

A complex combination of hydrocarbons obtained by treating cracked distillates with hydrogen in the presence of a catalyst. It consists of hydrogen and saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of C 1 through C5.
(EU Category: Refinery Gases, Category 35)

068478-30-8

Tail gas ***(petroleum), hydrodesulfurized straight-run naphtha separator***

A complex combination of hydrocarbons obtained from hydrodesulfurization of straight-run naphtha. It consists of hydrogen and saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of Cl through C6.
(EU Category: Refinery Gases, Category 35)

0685 13- 14-4

Gases (petroleum), catalytic reformed straight-run naphtha stabilizer overheads

A complex combination of hydrocarbons obtained from the catalytic reforming of straight-run naphtha followed by fractionation of the total effluent. It consists of hydrogen, methane, ethane and propane.
(EU Category: Refinery Gases, Category 35)

068513-18-8

Gases (petroleum), reformer effluent high-pressure flash drum off

A complex combination produced by the high-pressure flashing of the effluent from the reforming reactor. It consists primarily of hydrogen with various small amounts of methane, ethane, and propane.
(EU Category: Refinery Gases, Category 35)

068513-19-g

Gases (petroleum), reformer effluent low-pressureflash drum off

A complex combination produced by low-pressure flashing of the effluent from the reforming reactor. It consists primarily of hydrogen with various small amounts of methane, ethane, and propane.
(EU Category: Refinery Gases, Category 35)

0685 13-68-8

Residues (petroleum), deethanizer tower

A complex residuum from the distillation of a gas stream containing hydrogen, carbon monoxide, carbon dioxide and hydrocarbons having carbon numbers in the range of Cl through C6 or from the cracking of ethane and propane. It consists of hydrocarbons having carbon numbers in the range of C2 through C6. It may contain small amounts of benzene.
(EU Category: Refinery Gases, Category 35)

068527-13-g

Gases (petroleum), acid, ethanolamine scrubber

A complex mixture separated from refinery gas by scrubbing with ethanolamine. It consists primarily of hydrogen sulfide and carbon dioxide. It may also contain various small amounts of hydrogen, carbon monoxide and nitrogen.
(EU Category: Refinery Gases, Category 35)

068527-15-1

Gases (petroleum), oil refinery gas distn. off

A complex combination separated by distillation of a gas containing hydrogen, carbon

monoxide, carbon dioxide and hydrocarbons having carbon numbers in the range of Cl through C6 or obtained by cracking ethane and propane. It consists of hydrocarbons having carbon numbers predominantly in the range of C 1 through C2, hydrogen, nitrogen, and carbon monoxide.
(EU Category: Refinery Gases, Category 35)

068602-82-4

Gases (petroleum), benzene unit hydrotreater dependanizer overheads

A complex combination produced by treating the feed from the benzene unit with hydrogen in the presence of a catalyst followed by dependanizing. It consists primarily of hydrogen, ethane and propane with various small amounts of nitrogen, carbon monoxide, carbon dioxide and hydrocarbons having carbon numbers predominantly in the range of Cl through C6. It may contain trace amounts of benzene.
(EU Category: Refinery Gases, Category 35)

068602-84-6

Gases (petroleum), secondary absorber off, jluidized catalytic cracker overheads fractionator

A complex combination produced by the fractionation of the overhead products from the catalytic cracking process in the fluidized catalytic cracker. It consists of hydrogen, nitrogen, and hydrocarbons having carbon numbers predominantly in the range of Cl through C3.
(EU Category: Refinery Gases, Category 35)

068607-11-4

Petroleum products, refinery gases

A complex combination which consists primarily of hydrogen with various small amounts of methane, ethane, and propane.
(EU Category: Refinery Gases, Category 35)

068783-05-l

Gases (petroleum), ammonia-hydrogen sulfide, water-satd.

A water-saturated gas produced by the treatment of waste process water through steam stripping. It consists of up to 30% hydrogen sulfide and up to 60% ammonia.
(EU Category: Refinery Gases, Category 35)

068783-06-2

Gases (petroleum), hydrocracking low-pressure separator

A complex combination obtained by the liquid vapor separation of the hydrocracking process reactor effluent. It consists predominantly of hydrogen and saturated hydrocarbons having carbon numbers predominantly in the range of Cl through C3.
(EU Category: Refinery Gases, Category 35)

068814-67-5

Gases (petroleum), refinery

A complex combination obtained from various petroleum refining operations. It consists of hydrogen and hydrocarbons having carbon numbers predominantly in the range of Cl through C3.
(EU Category: Refinery Gases, Category 35)

0688 14-90-4

Gases (petroleum), platformer products separator off

A complex combination obtained from the chemical reforming of naphthenes to aromatics. It consists mainly of hydrogen and saturated hydrocarbons having carbon numbers predominantly in the range of C2 through C4.
(EU Category: Refinery Gases, Category 35)

068911-58-o

Gases (petroleum), hydrotreated sour kerosine dependanizer stabilizer off

The complex combination obtained from the dependanizer stabilization of hydrotreated kerosine. It consists primarily of hydrogen, methane, ethane, and propane with various small amounts of nitrogen, hydrogen sulfide, carbon monoxide and hydrocarbons having carbon numbers predominantly in the range of C4 through C5.

(EU Category: Refinery Gases, Category 35)

068911-59-l

Gases (petroleum), hydrotreated sour kerosine flash drum

A complex combination obtained from the flash drum of the unit treating sour kerosine with hydrogen in the presence of a catalyst. It consists primarily of hydrogen and methane with various small amounts of nitrogen, carbon monoxide, and hydrocarbons having carbon numbers predominantly in the range of C2 through C5.

(EU Category: Refinery Gases, Category 35)

068919-01-7

Gases (petroleum), distillate unifiner desulfurization stripper off

A complex combination stripped from the liquid product of the unifiner desulfurization process. It consists of hydrogen sulfide, methane, ethane, and propane.

(EU Category: Refinery Gases, Category 35)

068919-02-8

Gases (petroleum), jluidized catalytic cracker fractionation off

A complex combination produced by the fractionation of the overhead product of the fluidized catalytic cracking process. It consists of hydrogen, hydrogen sulfide, nitrogen, and hydrocarbons having carbon numbers predominantly in the range of Cl through C5.

(EU Category: Refinery Gases, Category 35)

0689 19-03-g

Gases (petroleum), jluidized catalytic cracker scrubbing secondary absorber off

A complex combination produced by scrubbing the overhead gas from the fluidized catalytic cracker. It consists of hydrogen, nitrogen, methane, ethane and propane.

(EU Category: Refinery Gases, Category 35)

0689 19-04-o

Gases (petroleum), heavy distillate hydrotreater desulfurization stripper off

A complex combination stripped from the liquid product of the heavy distillate hydrotreater desulfurization process. It consists of hydrogen, hydrogen sulfide, and saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of Cl through C5.

(EU Category: Refinery Gases, Category 35)

0689 19-07-3

Gases (petroleum), platformer stabilizer off, light ends fractionation

A complex combination obtained by the fractionation of the light ends of the platinum reactors of the platformer unit. It consists of hydrogen, methane, ethane, and propane.

(EU Category: Refinery Gases, Category 35)

0689 19-08-4

Gases (petroleum), preflash tower off, crude distn.

A complex combination produced from the first tower used in the distillation of crude oil. It consists of nitrogen and saturated aliphatic hydrocarbons having carbon numbers predominantly in the range of Cl through C5

(EU Category: Refinery Gases, Category 35)

068919-12-o

Gases, (petroleum) unifiner stripper

A combination of hydrogen and methane obtained by fractionation of the products from the unifiner unit.

(EU Category: Refinery Gases, Category 35)

068952-79-4

Tail gas (petroleum), catalytic hydrodesulfurized naphtha separator

A complex combination of hydrocarbons obtained from the hydrodesulfurization of naphtha. It consists of hydrogen, methane, ethane, and propane.

(EU Category: Refinery Gases, Category 35)

068952-80-7

Tail gas (petroleum), straight-run naphtha hydrodesulfurizer

A complex combination obtained from the hydrodesulfurization of straight-run naphtha. It

consists of hydrogen and hydrocarbons having carbon numbers predominantly in the range of Cl through C5.
(EU Category: Refinery Gases, Category 35)

068955-33-9

Gases (petroleum), sponge absorber off, fluidized catalytic cracker and gas oil desulfurizer overhead fractionation

A complex combination obtained by the fractionation of products from the fluidized catalytic cracker and gas oil desulfurizer. It consists of hydrogen and hydrocarbons having carbon numbers predominantly in the range of Cl through C4.
(EU Category: Refinery Gases, Category 35)

068989-88-8

Gases (petroleum), crude distn. and catalytic cracking

A complex combination produced by crude distillation and catalytic cracking processes. It consists of hydrogen, hydrogen sulfide, nitrogen, carbon monoxide and paraffinic and olefinic hydrocarbons having carbon numbers predominantly in the range of C 1 through ***C6.***
(EU Category: Refinery Gases, Category 35)

Note 1

There are a total of 161 CAS numbers included in the Petroleum Gases Category. Of these 161, 153 are listed on the HPV substances list. The Testing Group has included an additional eight CAS numbers that cover substances similar to those on the HPV list. The eight additional substances are noted by a ***(not HPV listed)*** designation after their respective CAS numbers.

Note 2

The Petroleum HPV Testing Group has included in its listing of CAS numbers an indication of the corresponding category adopted by the European Union (EU) in their legislation (Official Journal of the European Communities, L84 Volume 36, 5 April 1993, ***Council Regulation (EEC) No 793/93 of 23 March 1993 on the evaluation and*** control ***of risks of existing substances).*** Given the Testing Group's prediction that the toxicity of any stream can be predicted based on knowledge of its components, for the purposes of the HPV program, the separation of petroleum gas streams into two categories per the EU classification system is unnecessary. The EU category information is being included in this test plan to facilitate the international harmonization of classification and the coordination of efforts to summarize existing data and develop new hazard data that will be appropriate for hazard and risk characterization worldwide. In doing so, it will help avoid unnecessary duplication of testing.